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" Fuel and the Future "

Last week there was held in London a large-scale conference organised by the Ministry of Fuel and Power on fuel economy. The choice of the title, " Fuel and the Future," was not a happy one, unless the immediate future is implied. Well over 150 Papers were presented, and every aspect came in for consideration. Though the ferrous foundry industry was not treated as a special entity, there were many contributions which threw light on technical aspects of its fuel economy campaign. The non-ferrous section, on the other hand, were in the limelight. It is generally thought that this branch needed more attention, as in pre-war days, it was commonly said that a mistake in the buying of the raw materials would more than neutralise any efforts directed towards the more economical use of fuel. In these days of fixed prices, however, fuel economy is a factor of increasing importance, as indeed is all technical efficiency. By and large, the wide scale inspection of ironfoundries during the war confirmed that cupola practice had attained a reasonably high level of efficiency, and the major economies could be looked for in the better planning of work so as to give longer melting periods, and in such auxiliary plant as mould drying stoves, core ovens, space heating, and losses consequent upon the misuse of compressed air.

During the war we were seriously impressed with the fuel economy realised at the Stanton Gate steel bomb foundry, where the heat released from the cooling castings was utilised for heating up air for mixing with gas—the mixture being combusted in the core-drying stoves. As normally the iron-foundry industry makes about three million tons of castings per annum, the number of heat units uselessly dissipated must reach astronomical proportions. The office Brains Trust has calculated this to be of the order of 2,320,000,000,000 B.Th.U's. Obviously, the jobbing founders can only use this source of heat for unofficial tea making; but surely some of the large mass production concerns can with advantage emulate the Stanton practice. Even a railway chain foundry could heat the offices during the winter, if no better scheme could be envisaged. As for the motor vehicle casting trade, some of their foundries load up the debit side of the thermal balance sheet by consuming power for what they deem to be the orderly and controlled cooling of their castings. It must be admitted that this function is combined with the automatic sorting and handling of scrap to which credit must be given.

The problem of the utilisation of this potential source of power bristles with difficulties because of its intermittent production, for but few foundries work continuously day and night, and engineers, we believe, find heat storage difficult. The best solution so far found is by the use of reversible brick chequer work chambers of the type used in open-hearth furnaces. We commend the study of this phase of fuel economy to our young engineers, as its solution would constitute a development of the most meritorious type and of great industrial significance.

INDEX TO VOLUME LXXIX

The index to Vol. 79 (May-August, 1946) of the FOUNDRY TRADE JOURNAL is now available. Readers who desire a copy of the index should write to the Publisher, FOUNDRY TRADE JOURNAL, 49, Wellington Street, London, W.C.2.

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PERSONAL

THE EARL OF BALFOUR has resigned from the board of Bruntons (Musselburgh), Limited.

MR. BERTRAM JEFFRIES GEE has been awarded the William Macnab medal of the Institution of Chemical Engineers.

MR. W. H. MARSDEN has resigned his seat on the board of Cornercroft, Limited, precision engineers, etc., of Coventry.

MR. JAMES KENDALL has resigned his position as general manager of Grantham Productions, Limited, engineers, of Grantham.

MR. HARRY GREEN, secretary of Firth-Vickers Stainless Steels, Limited, since the company's formation in 1934, is to retire early next year.

MR. J. ROBERTSON FINNIECOME has been appointed chief technical engineer of Daniel Adamson & Company, Limited, Engineering Works, Dukinfield.

MR. CHARLES TOPHAM has retired after 52 years' service with Newton Chambers & Company, Limited. He was presented with a barometer by the staff.

MR. C. HIPWELL, general manager of Redpath, Brown & Company, Limited, structural engineers, etc., Edinburgh, has been appointed a director of the company.

SIR T. GUY WRIGHTSON, Bt., is this year celebrating his 50th year with Head, Wrightson & Company, Limited, Stockton-on-Tees. He has been chairman for 25 years.

MR. GEORGE TURNER, who has retired after 50 years with the Camelon Iron Company, Limited, Falkirk, has received a presentation. He served as foreman fitter for many years.

MR. JAMES THOM, foundry foreman, who recently retired after 67 years' service with the Lochgelly Iron & Coal Company, Limited, has received a monetary presentation from his former colleagues.

MR. ARTHUR ANDREWS has retired from the managing directorship of F. Reid, Ferens & Company, Limited, electrical engineers, of Newcastle-upon-Tyne. He became apprenticed to the company 52 years ago.

MAJOR JACKSON MILLAR, who joined the Ministry of Supply in Scotland more than seven years ago and became Regional Controller of the Ministry, is returning to his own firm, Jackson Millar & Company, engineers' agents, of Glasgow.

MR. D. C. GUNN, until recently engineer, manager, and secretary of the Yorkshire Industrial Gas Centre Limited, Leeds, has been appointed director of research to the Incandescent Heat Company, Limited, and its associated companies.

MR. LAURENCE STANLEY KINNEAR, a director and secretary of the British Oxygen Company, Limited, has been appointed a managing director. MR. MALCOLM KIRK ARNOTT, chief accountant, has been appointed secretary of the company.

MR. H. V. SHELTON, general manager of the light castings department of Newton Chambers and Company, Limited, has been appointed deputy chairman of the British Ironfounder's Association. He is to be located in London and will take up his duties in the spring of next year. He joined Newton Chambers and Company in 1929 and was formerly engaged in the sales department.

MR. R. G. MCELWEE, manager of the ironfoundry division, Vanadium Corporation of America, Detroit, is to continue as chairman of the cupola research committee of the American Foundrymen's Association, with MR. A. E. SCHUH, director of research, U.S. Pipe & Foundry Company, Burlington, N.J., as vice-chairman. MR. E. H. STILWILL, chief metallurgist of the Chrysler Corporation's Dodge division, Detroit, will serve as secretary.

Wills

HALLAM, THOMAS, late secretary of Thos. Firth & John Brown, Limited, Sheffield £12,435

GREIG, E. C., late chief labour superintendent of the United Steel Companies, Limited, Sheffield ... £12,696

WINTERTON, HARRY, chairman and managing director of William Cumming & Company, Limited, manufacturers of foundry requisites, etc., of Glasgow, and a past-president of the Institute of British Foundrymen £4,485

RUHR STEELWORKS TO CLOSE

According to reports from Germany, five iron and steel plants in the British zone are to be closed down and production in another eight plants is to be reduced. The closings are attributed to a British decision dictated by the prevailing fuel shortage.

The plants to be closed are the Dortmund-Hörder Hüttenverein, Dortmund; the Mannesmann works, Grossenbaum; the Klöckner works, Osnabrück; the August Thyssenhütte, Hamborn; and the Heinrichshütte, Hattingen.

Coal stocks in the zone have been seriously depleted and the decision to close these works and to reduce production in others has been made in order to ensure that the fuel situation in Germany generally does not get further out of hand.

THE CARDIFF BRANCH OF James Howden & Company, Limited, engineers, of Glasgow, reopened on October 6 at 91-93, St. Mary Street, Cardiff. The branch is in charge of Mr. W. MacOwan, who will be responsible for the area covering South Wales and South-West England.

WE REGRET TO ANNOUNCE the death, which occurred last Sunday, of Mrs. H. Steven Jeans, mother of Mr. Harold Jeans, chairman of THE FOUNDRY TRADE JOURNAL. Mrs. Jeans celebrated her hundredth birthday some months ago. Her husband was at one time secretary of the Iron and Steel Institute, and a proprietor of our associated journal the IRON AND COAL TRADES REVIEW.

SCIENTIFIC MEASUREMENT IN THE FOUNDRY*

By A SCATTERGOOD

It is probably due to the antiquity of foundry work, that certain branches of the industry have been so tardy in making changes and keeping up with scientific developments. Up to the last decade, the iron-foundry industry was a notable example of this conservatism. Ever slow in making changes, it either could not, or would not, recognise the great strides being made with other cast metals to meet more exacting demands, and often a greater severity of service conditions.

Even in the field of cast metals, the application of scientific measurement to the development and improvement of the non-ferrous alloys, particularly the light alloys, gave these materials apparent great advantages over that much more complex material, cast iron.

The intensive, if somewhat belated, efforts made in the direction of both process and material, have contributed in no small measure to the advent of cast iron into this competitive field, not just on a price basis, but as a material with its own distinctive and often unique properties.

Scientific Methods

Iron foundrymen are at last beginning to understand the complexity of the materials with which they work. and this is only being made possible by enlisting the aid of science and methods of scientific measurement in the foundry. Scientific measurement covers not merely the process of collecting data, but implies first, the method, or methods by which measurements are made, secondly, a proper appreciation of the actual or relative accuracy of the data, the collection and analysis of such data, and lastly the interpretation and application of the knowledge so gained to subsequent events.

It is obviously a means of expressing information quantitatively, without the influence of preconceived opinion, and of minimising, if not actually eliminating, the effects of influences external to the particular portion of the problem under consideration.

By analogy, the problems of foundry technique are complex equations each of several or many interrelated variables, and the complete solution cannot be obtained simply by the study of a single set of values.

All variables having any bearing or effect upon the main issue, should be taken into consideration, and wherever possible, measured, in order to give accurately, a complete picture of conditions obtaining whilst changes in the primary variables are made.

Numerous examples of this form of co-ordinated measurement over a number of variables are afforded in technical problems of casting production. The determination of a suitable height for a cupola bed for instance, must be made in consideration with certain other factors, all of which influence the working efficiency of the subject. Apart from the size and design of the furnace, such variables as the quality of coke used, metal:coke ratio, blast velocity (as determined by pressure) and the required melting rate, all play an important part in ascertaining a suitable bed height for optimum working conditions.

Whilst adjustments are made to the latter, in attaining these conditions, the above factors must also be measured and where possible controlled, in order that fluctuations in their properties may not affect the main issue. The scope of application is governed by the field covered in the measurements and many published solutions to foundry problems are limited in their general helpfulness by this limitation in scope. It is a very obvious remark that a set of measurements can cover no more than the particular dimensions or properties that are being measured. All factors not so measured, usually because they are taken as being "standard" or in the absence of any positive information, taken as constant and thus ignored, must obviously be duplicated for the solution to apply on subsequent occasions. If no evidence be available as to what these conditions were, this duplication is purely a matter of chance. An example of the above, again from cupola practice, is a study of the relationships between metal temperature, melting rate, metal:coke ratio, blast volume and pressure, and cupola diameter. By means of the appropriate observations and measurements, it is possible to determine a practical co-relation of these factors. That co-relation, however, will depend upon the metal mix being a constant upon the coke quality and upon the atmospheric conditions. Each of these items is in turn, an equation of several measurable variables, so that for the complete general solution of the main relationships, these subsidiary problems must also be solved.

Determination of Blast Volume

In illustration of this, the correct determination of blast volume involves not merely reading the instrument, but making the proper corrections for temperature, pressure and humidity, in reference to what can be termed "standard air" (*i.e.*, dry air at 60 deg. F., 14.7 lb. per sq. in.).

In questions of measurement, the expression "standard" is taken as being a constant factor of one form or another with reference to which all measurements are made. It is a means of comparing the magnitude of a force or material against some predetermined constant, and thereby allows comparison between a set of variables by relating their individual sizes to that constant.

*A Paper read before the Lincoln section of the East Midlands branch of the Institute of British Foundrymen, Mr. J. C. Hallamore presiding.

Scientific Measurement in the Foundry

The absolute units of measurement are universally used and are imperial standards. Such constants as the inch and the pound are dimensions of a definite order, and all material dimensions of a linear or weight nature are expressed as a fraction or multiple of the absolute unit.

Empirical Standards

Empirical standards are laid down as a result of experience, or from a study of compiled charts relating to a particular variable. They are standards of a purely local use, and may or may not be expressed. Empirical standards are based upon absolute units of measurement, and form a basis of comparison for assessing the value of results obtained. Numerous examples of standards set empirically are to be found in the foundry technique, standard piecework production, standard furnace melting rate and standard costs being typical instances where performances are judged on empirical standards.

Tolerances

From a consideration of standards, there enters the question of tolerances normally to be expected in measurement. A tolerance of measurement in a material property or measuring instrument is the normally anticipated deviation away from the pre-determined standards. Scientific measurements in a foundry are usually made by calibrated instruments, not by absolute units of measurement, and for this reason, slight errors in accuracy are encountered. Furnace materials are usually weighed on spring scales for instance, and although these are accurate enough for most practical purposes, tolerances in measurement will exist. This particular aspect has been thoroughly stressed by D. J. Reese in his Paper, "Weighing Cupola Fuel and Metal Charges."

Closely associated with dimensional tolerances is the question of limits in working accuracy encountered in actual practice. Working limits of consistency in all aspects of practical measurement have to be allowed for as a result of numerous non-finite variables which prevent the complete operation of standard measurement. Illustration of this range in working measurements are afforded in numerous fields of foundry work. The weighing of furnace melting materials, for example, will vary over a certain range, depending upon the bulk or size of the material weighed. The theoretical contraction of a casting in the mould will also vary, depending upon numerous factors in general, and metal characteristics in particular.

In scientific measurement, readings are obtained by the application of many different instruments, apparatus, or processes, and the readings so obtained are rarely to be taken as having absolute value or meaning. New and revised forms of equipment are being sought and obtained with astonishing rapidity. The introduction of such improved method, does not necessarily mean the abandonment of previous methods or of results obtained by these earlier means. Co-relation of parallel observations, the establishment of correction factors and the reconsideration of previous records will oft-times enable the different methods to be used, one as a check up on the other. Where improved accuracy of determination is obtained, sometimes obscurities in the existing records may be illuminated. The tendency to reject new approaches to the problems because the old approaches have satisfied us in the past, is not infrequently a cause of losing a fuller value from existing information.

Better Temperature Measurement

A point in this connection is the temperature measurement of the higher melting point metals. Until recently the main form of pyrometer used was optical (disappearing filament). The handicap in the use of such an instrument was its calibration under black body conditions, and the empirical correction for the emissivity of the metal. The introduction of the

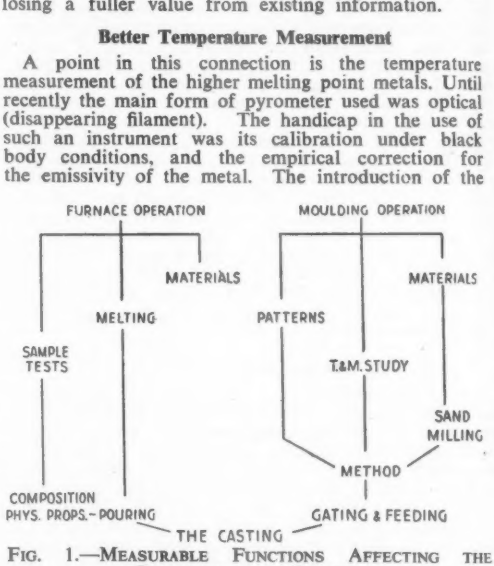

FIG. 1.—MEASURABLE FUNCTIONS AFFECTING THE CONDITION OF A CASTING.

Schoffield-Grace immersion pyrometer, has given the opportunity to obtain readings of closer approach to absolute accuracy. This does not mean that the optical pyrometer is obsolete, for emissivity (or correction factor) can be determined for any particular set of conditions, thus optical pyrometer readings can be obtained with a closer approach to true temperature than ever before. The new forms of measurement ensure (*a*) greater accuracy, (*b*) enables check to be made on existing methods, and (*c*) enables existing methods to perform with increased scope.

It is frequently impossible to measure variations that occur in properties of foundry materials in any direct way, *i.e.*, by the use of set standards designed particularly to measure changes in that variable. Fluctuations that do occur in foundry materials and processes are to a great extent common only to foundry practice and are not to be found in any other fields of measurement. Exceptions to this are, of course, numerous, dimensional measurements and analytical determinations, for example, follow the universally adopted methods of measurement, but apart

from this, and particularly in the more specialised aspects of foundry work, the standards of measurement have to be borrowed, as it were, to measure and detect variations in consistency.

Chill Wedge

An illustration of this form of co-opted measurement is afforded by the chilled wedge test, which, as the name implies, is designed to measure the tendency of an iron to chill when cooled. This tendency depends upon no one factor, but rather upon a combination of operative conditions, which will determine whether, or to what degree, a particular iron will chill. The problem then is twofold: (*a*) to stabilise the variables which may influence the chilling characteristics of the base metal, and (*b*) find some empirical standard by which this tendency to chill can be measured. When a particular property of any material,

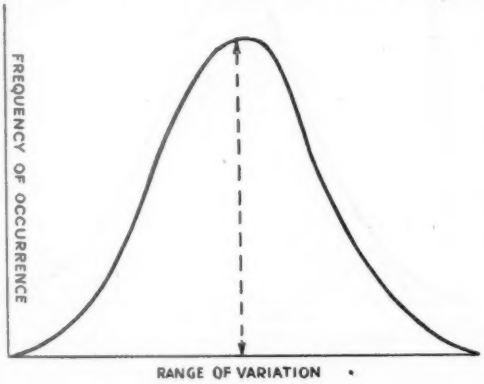

FIG. 2.—CURVE OF NORMAL DISTRIBUTION.

process or force is to be measured, all variables (and fluctuations within the variables themselves) must be standardised. They must be brought to a constant value while the primary measurements are being made. In the case of the chilled wedge test, this is achieved by a series of standardisations. The temperature of the molten metal to be tested, is taken with a pyrometer and cast into a cavity of set dimensions surrounded by baked core sand. Thus the tendency for an iron to chill, due to variations in casting design and changes in mould properties is eliminated. The test sample should be removed from the core at a definite temperature and quenched at an even rate. In this manner, each test-piece is cooled at a set rate and through an identical range of temperature. Therefore, the only remaining variable (being, of course, the primary one) is metal composition. Here the capacity of the metal to chill has been reduced to a purely linear function. If the metal has chilled under the conditions imposed during the test, it will be seen as cementite in the structure of the test-piece when broken. This chill will commence at the apex of the wedge (where cooling has been most rapid) and extend for a certain depth up the body of the casting, its extent depending upon the tendency of the iron to chill. Thus, by measuring either the width or the depth of the cementite belt, a ready means is obtained whereby the chilling properties of an iron may be accurately measured on a quantitative basis, capable of expression and comparison with tests taken from iron of that particular grade and a method of comparing the chilling properties of metals in all grades.

Reference to the genealogical chart (Fig. 1) indicates the main sections of foundry technique, which when combined form the basic operations in casting production. As measurement in the foundry is the subject of this Paper, it follows that consideration should be given to some of the more important aspects of measurement within these sections. Scientific measurement is established primarily as an aid to control upon all variables relevant to quantity or quality production, the interpretation of readings obtained, and the co-relation between measurement and control being discussed later. It is evident that though all metals will melt if raised to a sufficiently high temperature, melting furnaces are highly scientific instruments requiring the closest control. In the case of the cupola furnace this starts upon the receipt of raw materials and finishes as the metal leaves the spout. Thus their individual and relative values must not merely be static at one particular period, but be constant for the whole blow. For this reason, isolated measurements are not of true values, and are only indicative of conditions obtaining at that particular time. Where quality of metal is the determining feature, continuous measuring recorders should be installed. Whereas periodic readings upon furnace variables, as, for example, blast volume and tapping temperature, may give a general impression of working conditions, only a continuous recording instrument can give an accurate and precise picture of variations that occur in the melt. For, after all, the main purpose of scientific measurement in the foundry is not to confirm a state of control, but rather to detect any inconsistencies existing in this condition.

Analysis

The determination of the chemical and physical properties of a metal are well known and need not be quoted; sufficient to say that it is in this aspect of foundry work that scientific measurement has been developed to the highest degree. An interesting feature of present-day analysis is the speed and accuracy with which determinations can be made. On numerous routine analytical tests, results can be to hand in well under the hour of being cast, correct to very narrow limits of accuracy. This is a point of some importance in the control of continuous production, for the value of any measurement looses its significance with increasing time interval.

Scientific Measurement in the Foundry

Measurement in Moulding Materials

A casting depends to a large degree upon the chemical and physical properties of the sand in which it has been made for it to be perfect in outline and sound in structure. Depending upon the design of the casting and the metal in which it is to be cast, moulding sands must have varying degrees of permeability, bond, flowability, refractoriness, rammability, and have a fusion point well in excess of metal pouring temperature. These physical properties are controlled primarily by the chemical constituents of the sand, their shape, size, and distribution.

Most naturally bonded sands are composed largely of silica, and it is this material that determines to a great extent the performance of the sand when cast. Silica content usually ranges from 75 to 95 per cent. by weight, and can be taken as a fair index number of the refractoriness of the sand. Cohesion is imparted to the silica grains by alumina compounds, and varies from four to 10 per cent. It is upon the balance and proportions of these substances that the more important properties of the sand depend.

Sand Milling

Tests conducted upon moulding material must be continued through the sand milling stage, for here numerous forces are brought into operation which if misused can seriously impair the moulding properties of the sand. Overmilling of the sand, for example, is to be avoided, and therefore each milling should be mixed for a definite period of time. All millings should be weighed accurately, and any water additions, made by some appropriate measuring apparatus. Consideration of water additions to a milling brings to light an important practical implication of scientific measurement. Whilst it is generally recognised that wet moulding sand is a prime cause of scrap castings, it is a surprising fact that even in some of the so-called most progressive foundries there are either no facilities for measuring water additions, or instruments have been fitted to the mill and are broken or damaged. In some cases, flowmeters have been installed for this purpose, used for a period and then discarded because there has been no apparent improvement in working conditions. This outlook indicates an entirely incorrect interpretation of the purpose of scientific measurement. The very fact that measurements are made on the value of a variable quantity with no apparent improvement in the results is no reason for rejecting the evidence obtained or the instrument used. Rather is it an indication of the misuse of results and a wrong comprehension of the purpose of methods of measurements. There is no tangible relationship between measurement and control of product. The link up between these two factors rests in the analysis, interpretation, and use made of results, and depends upon the consistency of all other variables having any influence upon the properties of that product.

Moulding Method

The term "moulding method" indicates the different ways by which a mould can be made, and its measurement implies a manner whereby the size of all forces and materials used in moulding can be determined A large range of processes is being considered, extending from moulds produced by hand, to moulds produced almost entirely by mechanical power. As work performed by a machine for a given set of conditions is a constant, it is possible to measure the energy that is exerted on the mould. A craftman's skill, however, is unquantitative, and does not allow of any means of measurement. In this case, control is established by measuring the results of his efforts, *i.e.*, by testing the physical properties of the mould.

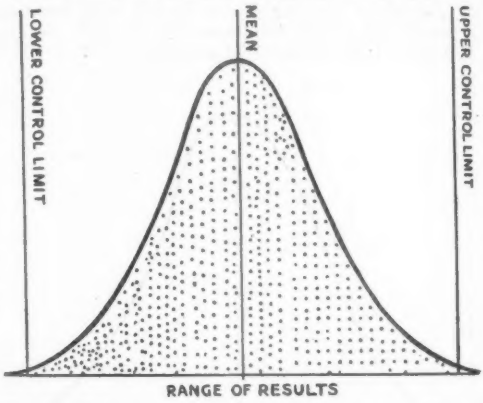

FIG. 3.—FORMATION OF CONTROL CHART BY THE USE OF FREQUENCY DISTRIBUTION CURVE.

Pattern Measurement

With regard to pattern measurement; these are, of course, of a linear nature and all salient dimensions should be checked regularly as proof against wear and distortion. Similarly, moulding boxes should be inspected for ill-fitting box pins and loose joints.

Reference to pattern equipment affords a suitable illustration of the extended use to which scientific measurement can be applied in exercising a form of control over all variables relevant to the production of a quality casting. The example in mind is of a case where small castings are being made on a piecework basis. Broadly speaking, the main measurable factors influencing output in this connection, are metal quality, condition of moulding sand, piecework standard (based on operator's efforts when working at "normal working rate"), and the general condition of pattern equipment. These main groups can all be divided into numerous sub-divisions, all contributing in some measure to the quality and quantity of castings produced. The workability of a pattern, for example, is governed by its intricacy of design and the con-

dition of the pattern surface. Moisture deposits from the surrounding atmosphere on to the pattern surface will cause sand from the mould to clog on to the face, and can seriously impede production. This occurrence will depend upon the temperature and humidity of the surrounding air and the temperature of the pattern, and must therefore be classed as a variable factor influencing mould production. Thus, by a process of measurement and control upon the main variables, additional measurements can be taken upon atmospheric conditions in an endeavour to discover the relationship between humidity and mould production.

Measurement of Human Effort

Turning now from materials measurements to a consideration of human effort and its measurement. The first serious attempt to compute output on a scientific basis was made by F. W. Taylor, an Ameri-

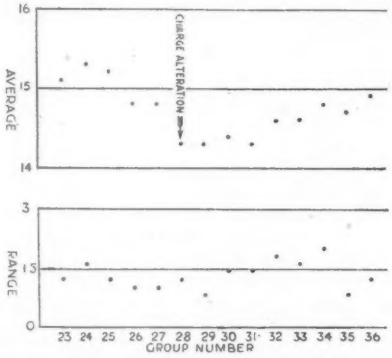

FIG. 4.—No. 6 MIX, CONTROL CHART—TENSILE STRENGTH.

can, and although his original system of wage payment did not meet with success in this country, the use of a stop watch for calculating operating times is still the standard method.

A properly organised piecework system can form the basis of all costing functions in a foundry and forms a good example of the expanded use of scientific methods of measurement. An interesting comparison may be drawn between the subsequent uses of piecework time measurements as a basis for financial control and the development of scientific measurements as an aid to technical control in a foundry. Both aspects are concerned with the measurement and control of all variables having any influence upon their respective purposes which, in the first case, is competitive costs, and in the latter, uniformity of product; the comparison lies in the methods of measuring, the interpretation of results and their subsequent use in additional fields of measurement.

In time and motion study, before any operational times are measured for a particular task, a preliminary series of observations are made, to determine which operations are relevant and which are unnecessary. At the same time, a survey is made of the plant layout to ensure that all equipment is conveniently placed and that all space is used to the best advantage. A series of readings are then taken over a long period by means of a stop watch upon each individual operation of the task. The data are analysed for any abnormal times which have been affected by some external factor and are ignored. The remaining times are averaged and thenceforth treated as standard for that particular operation. Thus the addition of all standard times give the possible time in which the job can be performed. The co-relation between wage payment and output varies for different cases, but the underlying idea is the same, *i.e.*, a system of increased wage payment for increased production.

The application of this knowledge to subsequent events is to be seen in most foundries where the price of a casting is regarded as being the lowest possible value which will satisfy the conditions of an exceedingly complex equation.

Production Cost

From a knowledge of standard times for standard operations for example, it is possible to estimate the production cost for new jobs. Costing functions are reduced to mathematical calculations, and future output can be calculated within narrow limits of accuracy.

So it can be seen that in the field of financial control, the scientific measurement of human effort has been developed to the nth degree. The measurement of technical aspects in foundry work can, and should be, conducted along similar lines. In illustration, one can take the case of chemical analysis, as an example of material measurement, and the development of results obtained, as an aid to control in subsequent events.

When a metal sample is analysed for any particular element, every care has to be taken to ensure that no external feature can in any way influence the value of that substance. For example, no slag or mould material should be mechanically suspended in the metal when cast, no change in state should occur when drilled or crushed, and no undesirable chemical conditions obtain during the actual analysis. Theoretically the result obtained is only applicable to the particular test-piece sampled, and whilst this can safely be taken as a representative figure when cast from a large bulk of metal, the assumption is not valid where metal is melted in a continuous furnace, as for example the cupola. Here a number of determinations must be made before an accurate picture is obtained as to the consistency of analysis.

Utilising Results

From this point, the value of results obtained will depend upon their subsequent use, they can form merely a basis upon which alterations to the metal charge is made, or they can become a standard of quality upon which the efficiency of furnace control and metal production is judged. Furthermore, the results of a set of analyses do not necessarily indicate the need for a

Scientific Measurement in the Foundry

change in the charge. Allowances must be made for deviations from a set standard due to tolerances permitted in measurement and limits encountered in working conditions. It would obviously be undesirable to affect a change in the base materials as a result of what probably happened to be an extreme case of variation in these practical limits.

A more logical line of action would be to determine what tolerances in metal composition due to inaccuracies in measurement and working conditions can safely be allowed before the material is considered out of control and the necessary correction made, to bring the material back to specification. It follows that as metal composition will depend entirely upon the material charged and upon furnace practice, chemical analyses (when suitably compiled) can form a criterion of consistency, both in metal quality and furnace operation. The use of chemical determinations can, under certain conditions, be advanced a stage further. It is the practice in many foundries in the United States to relate a furnaceman's bonus with consistency of chemical composition, *i.e.*, his bonus will increase, the nearer analysis results approach a standard value, and although there would appear to be some practical disadvantages to this method of wage payment, the case serves as an additional illustration of the manner in which initial measurements can be developed as an aid to control over further fields of foundry technique.

Gating and Feeding

The circumstances whereby metal will fill a mould cavity and faithfully retain the pattern contours after liquid shrinkage, depends upon a large number of factors, all of which, when taken individually, are capable of measurement. It is the infinite series of combinations that render a method of measurement almost impossible, and despite the large amount of investigational work done in this direction the method has as yet achieved no practical significance. Broadly speaking, the main factors determining the size and number of ingates and feeders for a particular job are casting design, mould properties and metal characteristics. These can be sub-divided into a large number of measurable items and will be combined in such proportions as determined by the size, shape and required properties of the job.

That a particular casting should be made in a high tensile iron for example will possibly involve a complete change, not only in the size and number of ingates and feeders, but also in the properties of the other contributory factors, *i.e.*, casting design and mould properties. Nevertheless, the matter is of such importance in foundry work that it is felt that if a practical relationship between ingate sizes and all assignable features could be established then a progressive stride would have been made in this particular section of the trade.

Therefore, at the moment all runner dimensions must be based upon empirical standards and should be governed by such controlling features as casting weight, maximum and minimum section thicknesses, the casting characteristics of the metal in which it is to be cast, and the necessary temperature at which it should be poured. Then, by compiling these relationships over a long period and by comparing individual results, a condition of control may be established which, if not strictly accurate will serve as a suitable yardstick for determining the dimensions of ingates and feeders upon future occasions.

Graphs

Practically without exception, scientific measurements are conducted on a process or material in order that control may be established either immediately or in the future. Usually a large number of measurements are made upon a variable over a long period and under all working conditions. It is upon the analysis of these data, the method of presentation, and a proper interpretation of the compiled figures that a successful co-relation between measurement and control may be maintained. As all relationships in measurement are expressed numerically, the most suitable way of recording results is by some graphical method. Whereas a whole mass of data can lead to confusion, a suitably prepared graph will clarify the picture and bring to light any peculiarities or extremes in the results which probably would not have been detected had the figures been tabulated in list form. Graphs have an additional advanatge of a two-dimensional nature, that is to say one variable may be plotted against any other influencing factor.

Frequency Distribution

The decision is then one of circumstance. As in this case the ultimate aim is to establish a state of control, the ideal chart will not only indicate the presence or lack of such a condition, but will also forecast in advance any possible deviation from conditions which are prevailing. The latest development in this direction, is the use of a chart based upon the principle of frequency distribution, which though somewhat complex in theory, is elementary in its application. The expression " control " is purely one of degree, for though the strict meaning of the word is to exercise constraint and to govern, in actual foundry technique this is rarely achieved for practical and economic reasons. Thus a material is said to be controlled provided it complies with the customer's specification or does not exceed empirical limits determined by foundry operation necessary for the production of a sound casting.

Should a material be specified as an 18- to 20-ton tensile iron, the melting process can be considered under control, whilst all results lie within this range. And if it is found necessary to mould the job in sand containing between 5 to 6 per cent. moisture, this particular aspect of sand preparation can also be considered as controlled provided all test data fall within these limits. It would obviously be undesirable to work to maximum degrees of tolerance, a substantial safety factor must be imposed to allow for any extreme inconsistency not detected in measurement. Thus, in the first case, limits of control would be set at something higher than 18 and lower than 20 tons

per sq. in. These are the actual working limits of accuracy within which all results must fall if a state of control is to exist.

Normal Law Curve

Whilst control limits may be set provisionally, or as a result of previous test data they can be determined theoretically from a study of the "normal law curve" (Fig. 2) as applied to a set of values. This curve adopts a definite mathematical profile and is the outcome of a phenomenon not solely confined to scientific test data but to all variables depending for their values upon a large number of chance causes. It is a natural law that most values will assemble around a common mode and will gradually decrease in a definite pattern as the difference from the mode increases. Then, if the distribution of values is normal and a sufficiently high number have been taken, the normal law curve will include for all practical purposes every single value. Then by the simple process of rotating the graph through 90 degrees, this distribution becomes a control chart where the mode of the curve indicates the desired standard and its extremities the control limits. For the sake of convenience and clarity a number of results are grouped together, their values are averaged and the lowest subtracted from the highest to give the range of results. Should any results fall outside the limits of these two charts the occurrence is indicative of lack of control and the need for the necessary corrective action.

A close study of the dispersion and trend of results plotted on these charts, may frequently be the means of preventing any lapse of control in the future. Thus, these charts form a suitable link-up between scientific measurement in the foundry and its primary object, control.

In conclusion, the Author reiterates the fundamental functions of scientific methods of measurement in a foundry. It is a datum line from which all attempts at control must emanate, and is the only accurate means whereby its degree may be expressed, void of any external or personal bias. It is a means whereby the accumulated knowledge gained from years of experience can be condensed into a simple and concise numerical statement. Scientific measurement is the foundryman's answer to the engineer's demands for a higher quality of product, an instrument to be used as aid to control and for furthering the development of foundry technique.

The Author's thanks are due to Qualcast, Limited, by whose permission the technical charts are published, and to Mr. C. A. Payne, works metallurgist, for his interest and constructive assistance in preparing this Paper.

MR. D. F. SAWTELLE, metallurgist, Malleable Iron Fitting Company, Branford, Conn., is chairman, and Mr. R. H. Jacoby, plant metallurgist, Key Company, East St. Louis, Ill., is co-chairman, of the 1946-47 sand shop operation course committee of the American Foundrymen's Association, the Chicago headquarters of the technical society announces.

NOTES FROM THE BRANCHES

WEST RIDING OF YORKSHIRE.—The closing date for entries for the S. W. Wise Memorial Prize is March 8, 1947. Papers for the competition, which may deal with any aspect of the foundry industry, should consist of around four or five thousand words. Lantern slide illustration will be permitted. Judgment as to the merit of a Paper depends on originality; its value to the founding craft; interest, and work involved in preparing the Paper. The winning Paper will be presented before the branch at the April meeting. The prize is three guineas, and will be presented at the branch annual general meeting. The conditions outlined above are open to amendment by the branch council as they may deem necessary.

In order to place greater branch library facilities at the disposal of members, a revision of library rules, an inventory of books at present at the disposal of members, and a revised system of indexing have been drawn up by a library sub-committee. Library membership cards have been issued to members with the 1946-47 syllabus, which contains, in addition, a revised list of books available and new rules for borrowing.

PRODUCTION OF IRON POWDER IN U.S.

A plant is being built on the Mesabi Iron Range of Northern Minnesota for the conversion of iron-carbonate slate to pure iron powder. The slate overlies the iron ore in great abundance and is easily accessible. Continental Machines, Inc., have contracted to operate the plant, which is being built by the State with funds appropriated from the tax on mining iron ore, administered by the Commissioner of Iron Range Resources and Rehabilitation. In a continuous chemical process, the iron is dissolved out of the ore by acid, precipitated as crystals of iron sulphate (copperas) and preferentially roasted to iron oxide of high purity. This product is then reduced to iron powder of controlled physical characteristics with a purity of over 99 per cent.

FRENCH METALLURGICAL CONFERENCE

The Société Française de Metallurgie is holding its autumn meeting, from October 22 to 24, at the Maison de la Chimie, 28, rue Saint Dominique, Paris, 7. The opening address is to be given by Prof. Portevin, followed by a lecture on Supersonic Testing, by Dr. C. H. Desch, F.R.S., president of the Iron and Steel Institute. Two sessions are to be devoted to Damping, Endurance and Fatigue, at which 15 Papers will be presented. Other sessions will cover "The Structure of Metals," and "Gases in Metals." An international flavour is to be given to the meeting as there are Papers from Great Britain, the United States, Belgium, Luxembourg, Czechoslovakia, and Switzerland.

CLEANING OF ZINC CASTINGS

In a recent issue of "Materials and Methods," two articles appeared on the subject of cleaning zinc die castings and alloys. The first is by Mr. C. H. Jeglum, of the Philadelphia Quartz Company:—

In the plating of die-cast parts cleaning prior to the plating operation is an important step. Failure to remove a tiny oil spot may cause the plating to peel; the redeposition of removed dirt of any sort is likewise detrimental.

Cleaning of die castings is usually done electrolytically. The metal castings are connected to electrodes and hung in baths of industrial detergents (which serve as the electrolyte) while a current, carefully controlled as to voltage and amperage, passes through the cell. Sometimes the castings are used as cathodes, sometimes as anodes, and it is not uncommon to reverse the current so that the casting acts as both.

Sodium silicates are among the alkalies used for this cleaning work. Recently, after failures in one operator's plating rooms were reported, tests were conducted to solve some of the problems entailed in the use of sodium silicates.

One of the questions to be answered was the effect of various silicate ratios. Accordingly, tests were run with 3 per cent. solutions of sesquisilicate, metasilicate, disilicate and trisilicate. Results were that with the disilicate and trisilicate a heavy white deposit of non-crystalline material almost completely covered the metal, while the other two silicate ratios left a bright or specular surface.

In the tests the specimens which served as cathodes retained the brilliance of the original. It was only on the anodes that the high silica solutions formed the deposit. It is clear, therefore, that zinc die castings should not be cleaned anodically in detergents; also, that meta- or sequisilicates are satisfactory for cleaning zinc die castings while di- or trisilicates are not.

Further tests indicated that at a temperature of 80 to 90 deg. C., and with a concentration of 3 per cent., sodium metasilicate will form no deposit and will not attack the metal. In general, lower temperatures increase the chance for anodic deposits, and higher concentrations may cause darkening of the anode. High current density also increases the tendency to form deposits.

The second is by Mr. F. Hazel and Mr. W. Stericker:—

There has been considerable disagreement in the past years as to whether zinc die castings should be cleaned with sodium silicates or even with compounds containing them. Investigation revealed the following:

(1) At 90.5 deg. C. and a current density of approximately 1 amp. per sq. decimeter, zinc or zinc casting alloys can be cleaned anodically in 3 per cent. solutions of sodium metasilicate or sequisilicate.

(2) Under the same conditions the sodium di- and tri-silicates give heavy white deposits on the anode.

(3) The formation of the anode deposit is not dependent on the silica content but on the $Na_2O:SiO_2$ ratio in the silicates employed.

(4) There is no deposit or attack on zinc or zinc alloy cathodes with the silicates alone under any of the above conditions.

(5) Lower temperatures or lower concentrations increase the probability for the formation of anodic deposits.

(6) Higher concentrations of sodium metasilicate cause brown streaks on the cathodes at 9 per cent. and darken the anodes slightly at 8 and 12 per cent.

(7) A definite minimum concentration of each chemical is required to prevent the formation of anodic coatings on zinc.

(8) Three per cent. solutions of sodium metasilicate, sesquisilicate or sodium carbonate can be used safely for anodic cleaning; the same concentrations of these and of trisodium phosphate, tetrasodium pyrophosphate and sodium metaphosphate are safe for cathodic cleaning.

(9) It is unnecessary to use soft water in the preparation of the baths.

(10) Rinse water should be as free from dissolved solids as possible.

(11) Higher current densities increase the tendency for deposits to form on the anodes.

(12) The conductiveness of 3 per cent. sesquisilicate and metasilicate solutions are high as compared with those of other materials except sodium hydroxide.

(13) The electrical resistance rises rapidly when deposits form on the electrodes.

Thus, the question originally posed can be answered by saying that not only can sodium silicates be used in cleaning zinc and zinc alloys, but when correctly selected silicates are used under controlled conditions, both attack and deposit on the metals are eliminated.

PUBLICATION RECEIVED

End of a Chapter. Published by Thos. W. Ward, Limited, Albion Works, Sheffield.

This well-illustrated 80-page brochure tells of the truly magnificent effort made by the publishers and their numerous subsidiary concerns. It has, because of the wide ramifications of the organisation, been an arduous task assembling the data provided. The reviewer, however, protests against the stressing—through the captioning of pictures—that foundry work is a dirty job. As the proprietors of Widnes Foundry, it is reasonably sure that the executives of that concern will not appreciate their difficult task being made more difficult by the stressing of this "dirt" aspect. The recovery of wrecks often supplies quite romantic stories, and many of those recounted record events displaying the utmost courage and resource. The story of the Silvertown depôt might have had as an introduction that it suffered much damage during the 1914 war. However, what is printed graphically depicts the nightmare bombing of 1940. The amateur photography used in one section is of a particularly high standard. Recipients of this brochure can indeed count themselves fortunate on receiving an authoritative account of a major industrial war activity.

FOUNDRY INDUSTRY REVIEWED

LONDON PRESIDENTIAL ADDRESS

An appeal for greater co-operation

The 1946-47 session of the London branch of the Institute of British Foundrymen opened with a very well attended meeting at the Waldorf Hotel, W.C.2, on September 25. The principal business was the formal assumption of the presidential duties by Mr. G. R. Webster, and the delivery of his presidential address, which is printed below. Later there was a discussion on the work of the Institute's Technical Council, which will be printed in a future issue.

MR. A. J. MURPHY, the retiring branch president, occupied the chair during the early part of the meeting. He recalled that he had had the privilege of proposing Mr. Webster's election at the annual general meeting, and that his election had given the members the greatest satisfaction. It was a special pleasure that the office should be occupied by one who had been such a hard worker for the branch and the Institute as a whole for so many years.

MR. WEBSTER then gave his inaugural address, in the course of which he said:—

Mr. Murphy and Gentlemen,—My first duty and pleasure is to express my sincere appreciation of the honour you have bestowed in electing me president of this branch, the largest, incidentally, in the I.B.F., and to thank you for the opportunity so given of further serving our Institute. I am very conscious of the high standard of erudition shown by previous presidents, a level which it is not easy to attain. I shall do my utmost to uphold the dignity of the office.

Each year, presidents are called upon to select a subject for occasions similar to this, the obvious and easiest choice being the particular branch of our profession in which the chooser is engaged, and many valuable contributions have been made to our knowledge in this way. However, I trust I shall not be judged presumptuous if I suggest a president of a branch, and, consequently, a member of the Council, should endeavour to take a broader view of our profession and its part in the affairs of the community.

The Institute can be likened to a growing tree. Its main branches, trunk and roots are marked with the rings of past history. Branches may be lopped off or even grafted on, but the change must not be too drastic and pruning must not be out of season. This is therefore a convenient stage at which to consider the relations between the Institute, its members and industry—the sap that keeps the tree of the organisation alive and vigorous. In all this the Institute must be careful not to spoil the balance and unity of its organisation, but it would seem past high time to do a little "window dressing."

Craftsmen of the Future

I need not describe to you the latest conditions (approved at the annual general meeting in June) which have to be satisfied for membership of our Institute, but would merely remind you that they fall into three categories—education, experience and ability to perform responsible functions, and that the rules permit of some latitude of the standard required in one category, provided it is compensated by special excellence in one or other of the remaining ones. These conditions have considerably strengthened the Institute, raising it to a still higher level. I wish to take this opportunity of stressing the need for our younger members to take a greater part in the affairs of the Institute. These craftsmen and technicians of the future are employed in many instances upon development and other important work, and the branch is now anxious to benefit by their ideas and views. Responsive action on their part will be welcomed and appreciated.

For every one person employed in the foundry industry, it can possibly be said without any exaggeration that it gives employment outside the industry to at least 10 others. The great progress in metallurgy and foundry science during recent years is, of course, closely reflected by the progress in machinery design, and much reduction of weight and great increase in power and speed of running have been rendered possible by the greater knowledge of the physical properties of the various materials used. It was perhaps inevitable that these advances should produce new anxieties and the necessity for increased vigilance and forethought. The soundness of all materials must be confirmed by experiment and test, including the use of X-ray and electron diffraction equipment, etc., and the existence of any critical condition under service conditions must be determined and provision made for avoiding entirely or minimising its effects.

A Most Important Factor

A sailing ship with its inherent defects of slow-motion or no motion, depending upon the wind, can be tolerated only for pleasure purposes. Speed and comfort, as we are all aware, are the order of the day. To this achievement the foundry industry has added no small quota. It is well to remember that one of the most important factors in the operation of all modern industries is castings. With the march of progress have come more general exacting demands, or it would be perhaps more correct to say that more exacting demands have brought about much of the progress.

Dr. James E. Mullen, of the U.S.A., writing in the American Press from his intimate knowledge of hazards in various types of industrial occupations, refutes some of the common notions regarding the so-called undesirability of foundry work in the expression "hot, heavy and dirty" as used in criticism of the industry. "Foundry work can be heavy, but not heavier or harder than found in many other industries. Dirty (relative), of course, referring to the moulding sand, which, although black, is clean. The flour-mill worker

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and baker get equally covered, but with a white dust which may contain much more actual dirt and many organisms—but it looks clean." He concludes by saying that the expression "hot, heavy and dirty" will be changed to "hot, heavy and healthy," with both foundry owners and workers paying attention to ventilation, mechanical safety, encouraging cleanliness and mutually adopting regular medical examinations during employment.

The tasks facing British foundrymen to-day are scarcely less of a challenge than those grim tasks so recently overcome. Production has a new battle cry—"Export." New high levels of prodution are required from our foundries, but new problems are arising—modernisation of the foundry, buildings, working conditions and amenities are vital factors in persuading an influx of new starters to take advantage of these amenities, to learn, and take pride, in being referred to as a foundry craftsman or technician. There is plenty of room in our industry for new talent.

Co-operation and Standardisation

I would here stress the vital theme—co-operation of labour, management, designer, customer, our own research organisations, the British Cast Iron Research Association, the British Non-ferrous Metals Research Association, and not forgetting the Council of Ironfoundry Associations—"Science married to Industry." Without it standardisation would be impossible, and without co-operation any human progress would be impossible. We cannot hope for a higher standard of life for the whole community, for very many years, than that of pre-war days. The enormous destruction and loss of war must be paid for in a general lowering of world standards. Strenuous efforts must therefore be made to increase individual and collective efficiency in order that we may maintain our standard of living, and for this the co-operation of each with all and all with each will be most essential.

Standardisation is of particular importance at present, when we are at the threshold of a new era. It is a fact that midway between the economic aspect and the purely technical aspect lies standardisation. Many of us in the course of our every-day work take standardisation for granted, thinking of it definitely, perhaps only when we find that a certain article is not sufficiently standardised for our purpose, or, on the other hand, that the standardised article does not quite meet our needs. It is not always appreciated, however, that the degree of standardisation of products usually indicates the degree of co-operation in the industry producing them; that in the past standardisation has been the result of sincere co-operation amongst users, amongst manufacturers, and between users and manufacturers. In all standardisation, sacrifices have to be made; and they have usually been willingly made when it has been realised that standardisation would be for the ultimate good of the industry. Standardisation is most highly developed in engineering, and if the relative developments in the various branches of the foundry industry are considered, it will be agreed that much more standardisation is possible and desirable.

It is sometimes said that the establishment of standards destroys initiative, but surely the standards themselves have been created through the initiative of individuals, and it is to be expected that, while prescribed standards will form the minimum for general performance, there will always be men of initiative aiming to do far better than the minimum. We must be prepared to follow the lead that they give and established standards must never come to be regarded as final, but must be subjected to constant revision as the technical level of achievement is raised by the initiative of individuals.

Costing

I would here stress the urgent necessity of a uniform costing system throughout the foundry industry. A golden opportunity of bringing such a general system into force during the war was not taken. The cost would have been comparatively small to instal such a system for, in war, "Time," not "Money," is important. Also, as our industry, like all others, was controlled by a Ministry, it would have been comparatively simple to have obtained unification. This problem, however, should not be left as it is, but perhaps it can be pursued to a satisfactory conclusion by the cohesion of the industry by the C.F.A. It is worth noting that the German ironfoundry industry had in operation a successful uniform costing system some eight or nine years ago.

I wonder how much of the criticism of planning arises from confusion between a plan and a blue-print. To assume that it is possible for any small body of men to get together and draw up detailed instructions for the thought and behaviour of large numbers of ordinary people is ridiculous. It is just as absurd and dangerous as the notion which a civilised world has been fighting against. Everyone of those ordinary people has individual ideas, preferences and characteristics, and each can make some contribution of value to the common good. The sole object of planning is to ensure that the individual contributions are directed into a common channel, such as through the C.F.A., thus leading to orderly progress and avoiding, so far as is humanly possible, the chaos of conflicting views which results in the frustration of individual effort. Uniformity of practice may be thrust upon us, but, even so, we are more likely to have the best practice if we ourselves are agreed as to what is best.

Secrecy

The knowledge and experience accumulated in our industry to-day is immense, and we have created the machinery in the Institute, the B.C.I.R.A., the B.N.F.M.R.A., and the C.F.A. to make it available at the appropriate time. But this knowledge and experience of to-day must be extended and developed to meet the requirements of to-morrow. Too many firms are still trying, through secrecy and out-of-date ideas, to keep each other ignorant of the things that

they already know. It is here worth remembering the vital words of Kelvin: "Until a quantity can be measured and expressed numerically, knowledge is necessarily restricted and improvement is slow."

The war years have shown that the foundry industry plays a more important part in our national life than many people, yes, apparently even the Government, realised. Foundrymen form a small proportion of the total population of any country, particularly our own, and their vital contribution to the national life and well-being seldom receives the recognition it deserves. Let us hope that the record of their achievements during the past few years will prove to be an exception.

Liaison

In fundamental matters there has been a very considerable degree of co-ordination during the past few years, and consequently we can now regard ourselves as comparatively well organised—as indeed we are. Those who have accused us of chaos and muddle, clearly know little about the industry, but we must take notice of what they say—as members of the public. In each firm there should be someone employed who is capable of understanding full developments outside their own industry, having perhaps a large and important influence on their own industry. Such an individual is a necessity in any undertaking, as a liaison between research and production, either research in their own organisation or, externally, to interpret results and problems into developments.

British industrial research, whilst frequently criticised adversely when compared with American or German research, has nevertheless an imposing record of achievement to its credit, and most of the industries of modern civilisation originated in the United Kingdom. We must see that other nations do not now outstrip us. Many industries are almost wholly based upon continuous research, but the directors of individual firms must be convinced that it is in their own and their shareholders' interests to devote resources to initiation or furthering of research within their own organisations or supporting the research associations, but nevertheless it must not be forgotten that great courage and judgement are needed in carrying out development in this uncertain world.

Recruitment and Training

May I now say a few words on one further matter which I believe will very materially affect our industry's future, and that is its relation to education? The war has already brought with it appreciable changes in the structure and working of our industry, and, above all, to the personnel concerned, and one cannot be other than alarmed at the reluctance of youths leaving school to enter into a skilled manual occupation. It is surely of the greatest importance to our industry that high manual skill should receive at least as good an opportunity of advancement as many "white-collar" jobs. The need for highly trained craftsmen in foundries is certain to increase, as also will the degree of skill required, and it would appear that the future will demand, after school-leaving age, and during apprenticeship, a part-time day continuation of non-vocational school subjects, to be followed at a later stage by the learning of a particular trade. This, of course, must be supplemented by undertakings offering progressive remuneration which will not only attract, but retain such men, coupled with a national taxation which does not render responsible positions unprofitable. It needs to be remembered that the commonest cause of frustration is the human element. Therefore, one of the most difficult problems, for which a solution must be found, is the provision of craftsmen and technicians to meet the demands being made on our industry. Starting with the raw material, it is not a matter of months, but of years, that is required to produce the finished article, and it is therefore, of little use to commence the training of large numbers when business starts to pick up, for, even when these become available for service, they will still lack that experience which time alone can bring. By no means every man capable of training to the work would be temperamentally suitable.

Your branch council were instrumental in starting a successful foundry course in the London area, at the Borough Polytechnic. You had first-hand information of this from the Principal, who gave us a most interesting Paper during the last session. In the future, as a result of the later school-leaving age and better guidance in choosing an occupation, the most intelligent types will already have undertaken a trade apprenticeship by the time they have reached the age when they can obtain employment as foundry workers.

Craft Training

Craft training has been divided into two parts, basic and applied. In all crafts there are a certain number of basic processes which experience and research have shown are best performed in a particular way. The raw trainee will adopt a different, and what appears to him, an easier way, unless he is compelled to follow the accepted method. These basic processes must be taught by experienced men who are familiar with the best methods and who have the right personality and ability to impart their knowledge; also, these processes must be taught under suitable conditions. I would very seriously commend the method of training sponsored by the Ministry of Labour under the title, "Training Within Industry," for all supervisors and works trainers. It has been most successful in America and this country.

Having passed his basic test, the youth is unlikely to spoil work and he becomes a revenue-earning employee from the moment he enters the shop. He does not take up men's time or distract their attention from their own jobs. Employers must remember these advantages and not grudge the cost of basic training. The introduction of certificates of craftsmanship would be of immense use; employers would find very acceptable both a certificate showing that the candidate has mastered the basic part of his training and one covering his entire apprenticeship.

Economic Development

Sir Clive Baillieu, president of the Federation of British Industries, said in March: "It was very easy to

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make vague general charges about the inefficiency of British industry. So long as economic development continued, there was always room for progress, but much that was being said about inefficiency and the alleged benefits of mechanisation was exaggerated. The test was not wholly and solely production per man-hour. A vital factor to-day was that of cost. In any case, a great deal of our production to-day cannot be wholly mechanised. In the present difficult transition phase, every demand for re-equipment, new developments, building and mechanisation involve competition for those two precious commodities—labour and savings. Every demand the Government made in this direction made a fresh claim on the country's limited resources.

"It was popular in certain circles to draw a picture of British industry as chaotic, inefficient, badly managed, operating in too small units, under-equipped and frequently indifferent to the tasks ahead. This, despite the fact that it had maintained 4½ million fighting men in the field for six years and had equipped them as well, if not better, than any other fighting force in the world.

"The production achievements of the U.S.A. were sometimes compared with our own, much to our disadvantage, but it was significant that the real income per head was not appreciably greater in the U.S.A. than in Britain before the war, and the U.S.A., which claims to be the most efficient producer in the world, surrounded herself with what he believed was the highest tariff barrier in the world. British efficiency would be glad of the opportunity to sell in the American market on both quality and price, provided it was given the chance to compete on equal terms with American efficiency. The charges made against the efficiency of British industry were not only unfair and inaccurate, they were also damn bad psychology."

State of Well-being

Cromwell, in one of his most famous speeches, said that "Objects of policy are two—being and well-being. The former must be secured before the latter can be attained." The foundry profession has indubitably secured its being, but there is less reason for confidence that it has yet attained a state of well-being.

Having no desire to stretch your patience beyond the elastic limit, if I have not already done so, may I in conclusion paraphrase a line of Swynburne which appears particularly applicable to our industry and to our institute?:—"All our past proclaims our future—we can be sure of the future because we are aware of the past," whilst particularly remembering the well-chosen words on the seal of our institute: "Science hand-in-hand with Labour."

Vote of Thanks

THE CHAIRMAN commented that the address, marked by such conciseness and profundity of thought, augured well for the success of the activities of the branch during the time when it was under Mr. Webster's direction.

(*Continued at foot of next column.*)

DR. A. B. EVEREST (past branch president), who welcomed the honour of proposing a vote of thanks to Mr. Webster, said tradition had laid it down that presidential addresses were not discussed. That was a great pity, because the president had raised many points which were of vital concern to the industry and which stimulated thought. He was a great authority on education, and the members hoped to hear more from him on the subject during his term of office. Dr. Everest also conveyed the best wishes of the branch to the president for a successful year of office.

MR. F. OLDERSHAW seconded, and the vote of thanks was carried with acclamation.

THE PRESIDENT then formally occupied the chair, and assured the members that he would do his best to further the interests of the industry and the Institute during his term of office.

INSTITUTE OF VITREOUS ENAMELLERS

ANNUAL CONFERENCE, 1946

The 12th annual conference of the Institute of Vitreous Enamellers is to be held at the Grand Hotel, Birmingham, from November 13 to 16.

The programme, in detail, is as follows:—

The council of the Institute are to meet at 8.30 p.m. on November 13, at the Grand Hotel.

The Papers to be presented on Thursday morning (November 14) are, "Observations on the Surface Qualities of Vitreous Enamel," by MR. W. E. BENTON; "Some Observations on the German Enamelling Industry," by MR. G. H. ABBOTT, and "Some Observations on Pressing and Deep Drawing," by PROF. H. W. SWIFT. Lunch is at 1 p.m., and at 2.30 coaches leave for Nuffield Metal Products, Limited, Washwood Heath. A visit to the Theatre Royal, Birmingham, is scheduled for 7.30.

Annual Meeting

The annual meeting of the Institute takes place on November 15, at 9.30 a.m. Mr. R. J. Rogers will then take the presidential chair and the officers will be elected. At 10.30 two Papers will be presented—"Mixed Acid Pickling," by DR. DE LATTRE, and "Observations on the American Post-war Enamelling Industry," by MR. A. BIDDULPH.

At 2.30 p.m., coaches leave for the Parkinson Stove Company, Limited, Stechford (continuous enamelling furnace), where tea will be offered.

In the evening, at 7.30, is the reception by the Lord Mayor of Birmingham, and the president. This is followed by the banquet and ball.

The Papers to be presented on November 16, at 9.30 a.m., are, "Influence of Cobalt and Nickel in Vitreous Enamel Ground Coats," by MR. G. C. PRIDLEY, and "Quality Testing, Shot and Grit," by DR. J. E. HURST. Lunch is at 1 p.m.

On Thursday, at 10 a.m., the ladies' party will leave Birmingham by coach for Stoke-on-Trent, where they will lunch. During the afternoon the party will pay visits to the Potteries.

Continued from previous column.

HEAT-TREATMENT OF GREY CAST IRON FOR RELIEF OF INTERNAL STRESSES

The following is the discussion on "Heat-treatment of Grey Cast Iron for Relief of Internal Stresses," by Mr. P. A. Russell. The Paper was presented at the Birmingham conference of the Institute of British Foundrymen earlier this year, and was published in the September 5 issue of the FOUNDRY TRADE JOURNAL.

Vote of Thanks

MR. F. J. COOK, in proposing a vote of thanks to Mr. Russell for his Paper, said that he personally had done much stress relieving both by heating and by putting them in a core stove, heating up to 450 deg. C, and then by putting them outside in the winter. After about five days that had been very effective. He had to produce rolls for automatic printing machines and he treated them in that way very effectively.

Seconding the vote of thanks, MR. A. TIPPER said it gave him very great pleasure to do so because he had served under him (Mr. Russell) on the technical council and seen something of the work he had put in in the interests of technical progress. He had called attention to a subject of considerable interest to producers of castings and one which would be receiving considerable study.

DISCUSSION

Design and Internal Stresses

THE CHAIRMAN (Mr. E. C. Dickinson), in putting the motion to the meeting, said his experience pointed to the fact that the main cause of internal stresses was bad designing. It could be very serious. He knew cases where such castings had given trouble even after two years' service, and he could confirm that the trouble was eliminated by annealing at 550 deg. C. Mr. Russell showed that one could not relieve internal stresses entirely even at 600 deg. C, but that 25 per cent. of the stresses would still be left in being. The great point was that the stresses had been appreciably reduced, and also the liability for cracking and distortion. Mr. Dickinson's experience was that by heating to 550 deg. C. it was a definite advantage. It not only removed the trouble, but it did not affect the physical properties of the material unduly.

MR. H. J. YOUNG said that for a number of years immediately following the first great war, all castings made under his control for the working parts of large marine Diesel engines—1,000 h.p. per cylinder—were stress-relieved by treatment at 400 to 450 deg. C. for about four hours. He had had no case of a casting distorting during heat-treatment of this order and no reason to require a more drastic treatment. If higher temperatures were to be used he would think it advisable to stabilise the pearlite by having present 0.5 per cent. or more of chromium. Incidentally, the above-mentioned temperature caused the iron to be slightly stronger than before treatment. He thought that three hrs. in a tumbling barrel would be as good as nine months' ageing, and again the iron would be rendered a little stronger. He had noticed a peculiar phenomenon in connection with individually-cast piston rings. By this process rings of automobile size were cast separately and, therefore, were thin castings having four-sided cooling in the mould. If fractured in one place, the ring was found to be under compression. This stress did not appear to be affected by removing the skin around the periphery of the ring, but was completely eliminated by machining the skin off the top and bottom surfaces of the ring. It might prove useful to follow up this and discover how much of what we called internal stress was, in fact, external. Those students desiring to acquaint themselves fully with this subject should study the presidential address of Mr. C. Heggie entitled "Strains and Warps in Light Castings," dated October 24, 1914. Mr. Heggie made many tests and one of the test-pieces he employed was identical to that now adopted by Mr. Russell.

Stress Relief and Temperature of Treatment

MR. C. GRESTY said that, while not wishing to question the main conclusions of the Author, he considered the curve given in Fig. 7 to be rather misleading as it indicated that no stress relief occurred on treatment at 400 deg. C. In his view, the results of the four tests averaged for the purpose of this curve were much too divergent for a reliable figure to be obtained. Actually, in the Paper as a whole, out of seven results of treatment at 400 deg. C., four showed that some stress relief had taken place and were in general agreement with the work of other investigators shown in Fig. 1.

Dealing further with the "average" curve in Fig. 7, he pointed out that in each of Tables I to IV the stress relief at 500 deg. C. was less than at some of the lower temperatures and a similar "kink" occurred in Table V, although at a slightly lower temperature. There was no indication, however, of a similar effect in Fig. 8, nor in the reference to the work of the other investigators. He would like Mr. Russell to elaborate on this point.

In page three of the preprint it was stated that in the two months between the cutting of the specimens and measuring, the gap was approximately 0.003 in. wider than the cutter in all cases, indicating that the stress had stretched the tie. Was this figure of 0.003 in. by any chance a printer's error as, according to his calculations, a stretch of this amount on the small tie would represent a stress of several times the ultimate tensile strength of the material?

Total Stress Relief Unnecessary

DR. A. B. EVEREST said that he was associated with the sub-committee of the technical council to which reference had been made in connection with the whole subject of stress-relief treatment. He felt that in considering Mr. Russell's Paper, it was necessary to maintain a balanced outlook. Mr. Russell had made it clear that he found it necessary to carry out his work because he found that engineers were expecting complete removal of casting stress following treatment at

Heat-treatment of Grey Cast Iron

relatively low temperatures. Mr. Russell's work was directed to showing that for such complete removal of stress a temperature approaching 550 to 600 deg. C. was necessary. For practical purposes, however, Dr. Everest felt that it was rarely necessary to aim at anything like 100 per cent. relief of stress. Lower temperatures were often quite satisfactory even if, as shown in the Paper, they only gave something like 25 per cent. relief, because, in point of fact, it was that 25 per cent. that mattered and would cause distortion or perhaps failure of the castings. As further evidence, he pointed out that many makers of high quality machine tools had found by experience that stability in the castings could be achieved even by weathering.

It could undoubtedly be accepted that temperatures as quoted by Mr. Russell were necessary for the complete removal of stress, but he strongly felt that foundrymen should not be put to the difficulty and inconvenience of using such high temperatures where all that was required was that the castings should be stabilised, provided it was understood by all concerned that full stress relief was neither intended nor achieved. He further pointed out that treatment at lower temperatures, sufficient for nearly all purposes, could be carried out in ordinary foundry equipment, such, for example, as an efficient core stove. He expressed his thanks to Mr. Russell for his work and the assistance it would give to the sub-committee.

MR. J. LITTLE said that a small point arose on the question as to whether in heating the test-bars at a low temperature it reduced the impact strength. In some bars at about the 500 mark it reduced the impact strength in some iron to about half.

AUTHOR'S REPLY

MR. RUSSELL, in his reply, said the question of heating in the core stove had been mentioned by Mr. Cook and other speakers. The main object of the Paper was that one could not get anything approaching complete stress relief without going above 525 deg. C. With regard to experiments with piston rings, he did some work with a ring test-piece, and also studied some work by Dr. Hurst on stress relief in piston rings, but he found his results were inconclusive. With regard to the question as to whether the stress was in the skin he could not give a definite answer. His own opinion was that it was not entirely in the skin. The point made by Mr. Gresty with regard to the stretching of the tie showed that it was not entirely a matter of the skin. Mr. Russell confirmed that the figure given in the paper of 0.003 was correct. The ends were trying to open all the time and the stresses were not measurable in tons per sq. in. in the ordinary sense. The growth of the tie was the most remarkable feature of the experiment.

Objection had been raised to the figures of average graphs. He found the greatest difficulty in forming any logical conclusion from the date, and he had submitted

(*Continued at foot of next column.*)

FORTHCOMING EVENTS

(Secretaries are invited to send in notices of meetings, etc., for inclusion in this column.)

OCTOBER 18.

Association of Special Libraries and Information Bureau (Northern branch):—"Information Service and the Export Trade," by A. B. Agard Evans. At Hornby Library, William Brown Street, Liverpool, 3, at 3 p.m.

Institution of Mechanical Engineers:—General meeting. Presidential address. At the Institution, at 5 p.m.

OCTOBER 23.

Association of Bronze and Brass Founders (London and Home Counties area):—Informal meeting. At Brown's Hotel, London, W.1, at 12.45 p.m.

Royal Statistical Society—Industrial Applications Section (Birmingham and District group):—"Market Research," by A. S. Wharton. At the Chamber of Commerce, 95, New Street, Birmingham, 2, at 6.30 p.m.

OCTOBER 25.

Manchester Association of Engineers:—"Production of Flat Surfaces" (Discussion). At the Engineers' Club, 17, Albert Square, Manchester, at 6.45 p.m.

Institute of British Foundrymen

OCTOBER 23.

Birmingham, Coventry and West Midlands branch:—"Malleable Cast Iron," by H. G. Hall. At the James Watt Memorial Institute, Great Charles Street, Birmingham, at 7.15 p.m.

RAPIERS' APPRENTICESHIP SCHEME

Ransomes & Rapier, Limited, of Waterside Works, Ipswich, have sent us details of their apprenticeship scheme, mainly for engineers. The system includes part-time attendance at the local school of technology, and from the examinations the firm select the best, who receive special encouragement. Instead of giving pictures of the interior of the works, reliance has been placed on presenting to the applicants and their parents illustrations of the products made.

(*Continued from previous column.*)

the date in full to show he had not hidden anything. He attempted in Fig. 7 to give average results. The average result was nil at 400 deg. C. in the first four series, although he agreed there was a certain amount of relief shown in some cases at 400 deg. C. It was suggested there was a kink at 500, and he had been tempted to draw attention to that himself. The bulk of the work they were called upon to do was done at 500 deg. C. and the experiments seemed to show it was the worst possible temperature that could have been chosen. He came to the conclusion that the measurements were so open to inaccuracy that it would not be fair to draw any definite conclusion from the apparent kink at 500 deg. C. Dr. Everest had stressed that 100 per cent. relief was not needed in castings. So many people thought they were going to get complete stress relief by putting castings in a core stove at 300 to 400 deg. C, and he maintained that he had shown that very little good was done by such treatment. Mr. Little's remarks were interesting, but there was some evidence that low temperature heat-treatment was a stabilising factor which was contrary to Mr. Little's remarks.

PRODUCTION OF CAST-IRON PORCELAIN-ENAMELLED BATHS IN GERMANY*

By Lt.-Col. R. L. HUNTER, B.Sc.

Targets

This investigation is to be considered as supplementary to the compiler's previous report on vitreous-enamelled sheet-iron baths.† It is not described in such detail, as another team of six members visited the same firms and is submitting a more comprehensive account.

Before the war the manufacturers of cast-iron baths in Germany were all included in a federation known as the Güssemaille Syndikat, which, with the British Bath Manufacturers' Association, formed the International Bath Association. The manufacturers included in the German association were as follows:—

(1) Bayerische Berg-Hutten und Salzwerke A.G., München-Bodenwöhr; (2) Buderus'sche Eisenwerke, Essen Kray; (3) Holler'sche Carlshutte, Rendsburg; (4) Warsteiner und Herzoglich Schleswig-Holsteinische Eisenwerke A.G. Henriettenhutte, bei. Leignitz; (5) Eisenwerk Laufach A.G., Karlstadt a/M.; (6) Mitteldeutsche Stahlwerke A.G. Lauchhammerwerk, Gröditz; (7) Luneburger Eisen-und-Emaillierwerke Harry Behrens, Luneburg; (8) Moll & Rohwer, Neümunster; (9) Nationale Radiator G.m.b.H., Berlin-Neuss; (10) Burger Eisenwerke G.m.b.H. Schelderhütte, Burg/Hessan-Nassau; (11) Eisenhüttenwerk Thale A.G., Thale am Harz; and (12 Wilhelmshutte Eisen-und-Emaillierwerke A.G., Sprottau-Wilhelmshütte.

There were another three firms in Vienna, Poland and Czechoslovakia.

Of the above 12 firms, No. 8 had gone out of business, No. 9 had been demolished by bombing during the war, Nos. 4, 6, 11 and 12 were in the Russian zone, and Nos. 1, 5 and 10 were in the American zone. The remainder were in the British zone. All were visited and are reported on below.

LÜNEBURGER EISEN-UND-EMAILLIERWERKE

This firm is actually in production on baths, and has been so for some time, under permit from the military government. They also manufacture cast-iron basins, flushing cisterns, stoves and other builders' castings. Before the war their output was about 150 baths per day, and they did a fair export trade to the U.K. The present general manager is Herr Behrens, son of the founders. He had three brothers, all of whom were killed in the war. They were members of the Nazi party, which Herr Behrens was not. He spoke fluent English, having been in England on business several times before the war, and was ready to give all information and assistance required.

Patterns.—These are made in cement, 3½-mm. sheet iron and machined cast iron. The sheet-iron patterns are carried in a steel frame, and are sprayed with aluminium by a process similar to metallising. Great care was taken with patterns in this as in all the works visited, and the pattern shops rather resembled machine shops.

Moulding.—Two block patterns are used, one for the drag and one for the top part. There are four men in the squad, two to each pattern, of whom one has a pneumatic rammer, the other man shovelling in sand. The air pressure is 7 atm. (100 lb. per sq. in.), and the rammer is heavy. The output is about 10 per day from the four men. These men were all unskilled, apart from the foremen and chargehands. The quality of the castings was rather below that of this country at present, but in the circumstances they were very good. It was

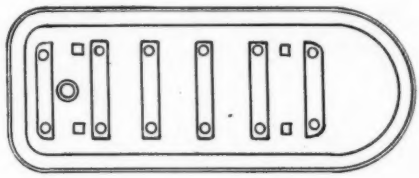

FIG. 1.—GATING SYSTEM.

stated that no finishing of any kind was done, either by spraying or dusting on graphite. It is understood the other team were told differently, but the compiler believes the above to be correct, as it was verified by the foundry foreman, and the castings as taken from the mould had sand adhering to them closely all over, indicating that no finishing substance had been used.

Metal

The cupola charge is 500 kg. (10 cwt.), made up as follows:—

150 kg. Hematite.
100 kg. No. 4 pig.
15 kg. Ferro-siliceous pig.
100 kg. Scrap.

From which a cast metal of the following composition was obtained:—T.C., 3.4; Gr, 2.9; Si, 2.6; Mn, 0.5; S, 0.10; and P, 0.8 per cent.

Sand Preparation.—The sand was put through a machine of the "Prosama" type about three times per week.

*Slightly abridged from B.I.O.S. Final Report No. 437.

†The Report on Vitreous-enamelled Sheet-iron Baths, was published as B.I.O.S. Final Report No 344.

Cast-iron Bath Production in Germany

Method of Gating.—There are 13 gates arranged along the bottom of the bath in pairs, as shown in Figs. 1 and 2. The ladles are in the form of cylinders carried on trunnions, with a gap in the middle for filling and emptying, as shown in Fig. 3. This type of ladle was common to all the works visited.

Dressing.—Baths are sand-blasted in a chamber sand blast, buffed and stoned, but are *not* given a second sand blast afterwards, as is the practice in this country, and, in fact, in other German works. The castings at present are not too good, and there is quite a lot of buffing to be done. Loss in process is said to be three per cent. in the moulding shop and five per cent. in the enamelling shop.

Enamelling

Muffles are gas fired from producer gas made on the premises from briquettes. There are three men in the enamelling squad, one dusting the inside, one dusting the rolls and one controlling the turntable. No power is used either on the turntable or on the door gear. A sheet-steel frame prevents dust going on the outside of the bath. The fork is heavy and slung from overhead rails. The turntable is well made mechanically

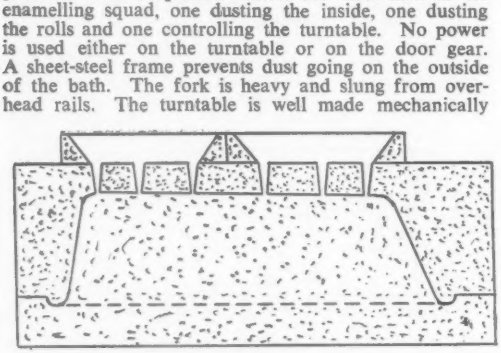

FIG. 2.—SECTION THROUGH MOULD.

and works very smoothly. After enamelling, the bath is placed in a cooling chamber beside the furnace.

The melters are gas fired, and the melted enamel quenched by allowing it to fall into water, as in the U.K. It is afterwards dried in large trays. They have a rotary melter, but it has not been used for years, as it was not found to be satisfactory. They have also an elaborate sieving machine to cut out black specks, but they considered it doubtful if it really was of much use.

Enamel-powder for bath tubs:

	kg.
Quartz	28.2
Felspar	8.4
Fluorspar	9.0
Calcium carbonate	1.4
Sodium nitrate	3.4
Sodium silico-fluoride	3.1
Barium carbonate	13.5
Zinc oxide	11.6
Sodium carbonate	1.0
Antimony oxide	2.5
Barium fluoride	4.7
*V26	11.0

For the roll of baths:
Quartz ... 26 kg.

For the mill:
6 kg. G.A.M. 480 (Vienne) for 100 kg.

Wet enamel for lavatory basins:

	kg.
Quartz	24.0
Felspar	28.0
Borax	6.5
Boracic acid	4.0
V26	10.5
Sodium carbonate	12.5
Saltpetre	3.0
Fluorspar	6.0

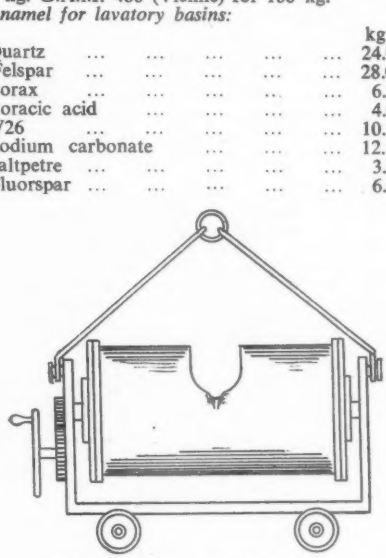

FIG. 3.—TYPE OF LADLE USED.

Sodium silico-fluoride	1.0
Barium carbonate	4.0
Zinc oxide	7.0
Antimony oxide	3.0
F.K. 2217	2.0
Flux 313	1.5

For the mill:
6 kg. clay; 1 kg. soda.

Other Products.—They make flushing cisterns on jolt-ram machines. One man per machine (1 on drags, 1 on top parts) make 100 to 120 per day. Working hours are 7 a.m. till 4.30 p.m. (1 p.m. on Saturdays). They also make basins on jolt machines, 35 to 40 per day from two machines—one man on each.

General Notes

They did not consider the sheet-steel bath a serious competitor, except for very cheap work or where light weight was a great advantage. They said it was liable to chip inside if it got a knock on the outside. The

* Product of I.G. Farbenindustrie.

cast-iron bath weighs 143 lb. for the casting plus 22 lb. enamel for a 5 ft. 6 in. overall, 3 in. roll bath. The baths are packed for export as shown on Fig. 4.

HOLLER'SCHE CARLSHUTTE

This firm was before the war one of the largest in Germany, with a daily production of 400 baths. They ceased manufacture of baths in November, 1944, and have not yet received permission from the British military government to recommence. They have reported that they are in a position to start at once with a production of 50 baths per day, with an increase to 118 per day in four weeks, and 240 per day in six months. No war damage was done to the works.

Patterns.—Great care was taken in the manufacture of patterns, which were in cast iron, carefully finished, with an internal mechanical device for withdrawing the foot-snug, so that cores were not necessary. It was stated that they took six weeks to make. The pattern shop was practically a machine shop. The patterns are all machined where possible, and the awkward shapes are finished with pneumatic or flexible shaft grinders, using the face of the stone as well as the edge.

Moulding.—Cast-iron block patterns were used, the squad consisting of two men on the drag and two on the cope. Pneumatic rammers are used. Four men do 14 or 15 baths per day. The patterns are parted from the moulds by pins for the first inch or so, and then lifted clear by cranes in the usual way. It was categorically stated that no finishing whatever was used, either by spraying or applied as a powder.

There is a large sand handling plant which takes sand from the knock-out grids by a bucket elevator. New sand is added, the mixture is tempered to the correct moisture, cooled while travelling up a long belt, then fed to hoppers over the patterns. The foundry manager said that he considered the sand of rather poor quality, inferior to that normally used in English shops which he had visited.

The cast metal used was of the following average analysis: T.C., 3.5 to 3.7; Si, 2.4 to 2.6; Mn, 0.6 to 0.8; S, 0.12, and P, 0.8 to 1.0 per cent. The high sulphur figure is said to be due to poor quality coke.

There are two sets of gates, which are carefully made to drawings, as shown on Fig. 5. The same type of bogie was used at Luneburg. They are relined twice a week, the parts being clipped together for easy separation, not bolted.

Sandblasting.—This is done on a revolving table type of machine at floor level, the blasting being automatic.

Enamelling.—The muffles and equipment were of the same type as at Luneburg, antiquated by British standards. When the works were visited, castings like wash boilers were being enamelled wet-process, a heavy fork, slung from a pneumatic hoist, being used.

Other Products.—Large quantities of these food vessels and basins were being made, but not flushing cisterns, which are considered too keenly cut in price.

BUDERUS'SCHE EISENWERKE

This firm had just recommenced the manufacture of cast-iron baths a day or so before the visit. About 50 per day were being made, compared with a pre-war output of about 150. There had been a little damage during the war, but mainly on shops not used for bath manufacture.

Patterns.—As in the other works visited, the pattern shop was more like a machine shop, but in this case it was used mainly for repair and maintenance, as the patterns were made by an associated works at Hirzenhain. Baths were also produced in small numbers at this branch before the war.

Moulding.—Moulding was done by jolt-ram machines, manufactured by Badische Maschinenfabrik, Durlach. These are similar to those installed in certain works in England. There are three sets of machines, of which only one set is in operation at present. The set consists of one machine for drags and one for top parts, operated by compressed air. Four per cent. coal dust is mixed with the sand, and no finishing of any kind is used. The sand is treated in an elaborate sand handling plant and delivered to the machines by chute. There are three men on the drag and four on the top part, which is placed on a stand for touching up before closing. The mould is very thoroughly pricked, the pricker being swollen near the point so that quite a large hole is made. When the mould is poured there are loud explosions and gases burn furiously at all the pricker holes, but the metal enters smoothly and quietly.

Ramming is finished off by pneumatic rammers. In the case of the core, special new sieved sand is used for clapping up by hand on the sides. The box carries a frame which occupies the inside of the bath,

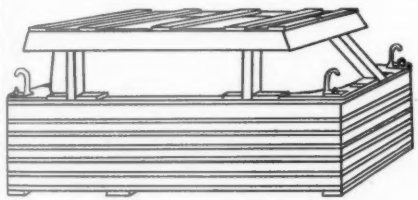

FIG. 4.—ARRANGEMENT USED FOR PACKING BATHS FOR EXPORT.

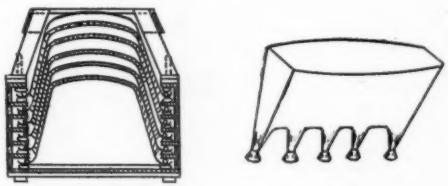

FIG. 5.—GATING ARRANGEMENT.

Cast-iron Bath Production in Germany

and the inside of this frame is not filled up with sand, presumably to allow easier escape of gas. There are three sets of gates, as in Fig. 6, one running directly across the waste. The casting is done by a separate squad, who also do the knocking out. Three ladles are used to pour the metal into the mould.

The average pre-war analysis of cast metal was as follows: C, 3.4; Si, 2.5; Mn, 0.45 to 0.55; S, 0.1 max., and P, 0.7 to 0.8 per cent.

Herr Klebisch the manager, was for many years with Standard Sanitary at Neuss. He considers the Sandslinger more efficient than his present plant.

Dressing

Castings from the foundry are placed on a conveyor and taken through an automatic sand blast (made by

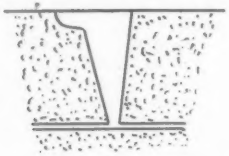

FIG. 6.—TYPE OF GATE USED.

Vogel & Schlemann, Hagen-Kabel) fitted with four nozzles. Both inside and outside are blasted clean of sand by nozzles placed as shown on Fig. 7. Flint is used as the abrasive. On leaving this plant the baths are turned mouth upwards on a machine and continue on the conveyor to the final sand blast. At this stage they are buffed with pneumatic grinders using chiefly the face of the stone, the securing nut being countersunk. The second sand blast is for the inside only, with two nozzles. The sand blasting is not very thorough by British standards. About 25 baths per hour are turned out on this plant. The baths then go to the enamelling shop on a power-driven conveyor.

Defective baths are repaired by electric welding, the welding rods being of cast iron, of the following analysis:—T.C., 2.25; Si, 3.63; Mn, 0.50; S, 0.122, and P, 0.88 per cent.

Enamelling

Muffles are coke-fired single furnaces, with horizontal sliding doors. The fork is hung from a jib. There are three men in a squad, two dusters and a wheelman, and they turn out 17 baths per shift. The turntable was fitted with a shield to prevent dust falling on the outside of the casting. The enamel is leadless but is not made on the premises but at Hirzenhain (Oberhessen). The average foundry loss given is seven per cent. Enamelling loss, four to five per cent. The quality of bath casting and finished enamelled bath was not good, but this is only to be expected so soon after restarting.

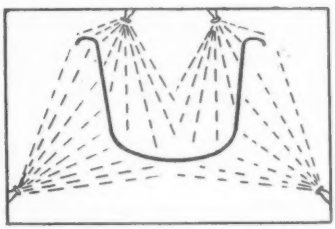

FIG. 7.—ARRANGEMENT OF NOZZLES FOR CLEANING.

Conclusion

The chief point of interest in the foundry is that none of the firms visited used any kind of finishing, although the baths were cast from the bottom in exactly the same way as in Britain. Natural sand was used. Another notable point is the great care taken with patterns and boxes, which were a carefully machined engineering job. This is the secret of the very light weights obtained by the Germans. A 5 ft. × 3 in. roll parallel bath weighs 176 lb. (enamelled including feet).

The output per man was not spectacular, but the German, even when unskilled, is a painstaking and competent workman, and can do a very good job with inferior plant. The enamelling shop plant is generally much less up-to-date than British plant.

NEW CATALOGUE

Steelworks Plant.—A new note in industry publicity has been struck by the Wellman Smith Owen Engineering Corporation, Limited, Victoria Station House, Victoria Street, London, S.W.1. More people than is generally realised are interested in maps. Thus a wise decision was taken to jacket the brochure in a highly coloured map of the world replete with sailing ships, dolphins and the usual decorations to be associated with the early cartographer. Excellent use has been made of colour throughout, but the main, and very clever, feature is the presentation of the letterpress in four languages—English, French, Russian and Spanish—by means of bound-in central 2½-in. wide inserts. These are, when the book is opened at any page, completely surrounded by numbered pictures, and a clear description is thus available in one language. By this means no fewer than 40 illustrations are fully dealt with. For this combination of real artistry and modern enterprise the reviewer tenders the publicity department of the issuing house his sincere congratulations.

HADFIELDS, LIMITED, announce that their London offices have been transferred to 22, Carlton House Terrace, S.W.1. (Telephone: Whitehall 7107.)

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Thickness	3¾ inches

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NEWS IN BRIEF

THE SCHEME FOR the establishment of trading estates in the Tees-side and Cleveland areas has been accepted almost in full by the Board of Trade, it was announced at a meeting of the Tees-side Industrial Development Board at Middlesbrough.

A NEW LIGHT INDUSTRY is being introduced at St. Austell, Cornwall, where a £15,000 factory for the manufacture of metal tubes and electric motors is nearing completion for A. G. Tourell & Company, Limited, Isleworth, Middlesex.

THE BOARD OF TRADE announce that up to August 31, 2,090 building projects for new factories and extensions to existing factories have been approved. These will eventually provide additional employment for 185,000 men and 139,000 women.

THE HOFFMANN MANUFACTURING COMPANY, LIMITED, of Chelmsford, are opening a branch office at 4, Salisbury Square, Salisbury Road, Cardiff (telephone: Cardiff 9318). An emergency stock of ball and roller bearings will be maintained there.

THOS. FIRTH & JOHN BROWN, LIMITED, have bought from the High Speed Tool Company of Canada, Limited, their plant at Galt, Ontario. Mr. Eric Mensforth, deputy managing director of the English company, is in Canada to manage production.

MR. JOHN WOLSTENHOLME, managing director of Walmsleys (Bury), Limited, manufacturers of paper-making machinery, etc., and his wife have given their home, Walshaw Hall, near Bury, as a hostel for aged Freemasons, their wives, widows, and dependants.

SIR MILES THOMAS, vice-chairman of the Nuffield organisation, said in London last week that total car production was increasing encouragingly, but they were standing at that moment in the shadow of a threat of a cut in sheet-steel quotas to the British motor industry next year.

PREFABRICATION IS BEING APPLIED to the laying of railway lines by the Southern Railway, which has allocated £100,000 to a track renewal programme to be carried out on this new system. The new system is expected to save 13½ per cent. in cost compared with the old method.

MR. JOHN HYND, M.P., Chancellor of the Duchy of Lancaster, recently visited the Donawitz iron and steel works at Leoben in Austria, which was reopened by the British Military Government two months ago. As yet only one blast furnace is operating, but it is already producing 450 tons of steel daily.

THIRTY STEELWORKERS who have had 50 years' service with Colvilles, Limited, were presented with cheques for £50 and certificates of long service at a gathering in Motherwell recently. Sir John Craig, chairman, who made the presentations, was himself presented with a certificate of 50 years' service.

THE ENGLISH ELECTRIC COMPANY, LIMITED, which recently purchased the whole of the shares of Marconi's Wireless Telegraph Company held by Cable & Wireless (Holding)—98½ per cent. of the issued share capital—has now offered to purchase the remaining shares on the basis of 17s. 6d. for each 10s. share and 35s. for each £1 share. The offer will remain open until December 31.

THREE MAJOR ALLOCATIONS covering almost half of the available factory space in Shorts' premises at Rochester have been made by the Board of Trade. B. & P. Swift, Limited, will employ about 450 men on the manufacture of gears, hydraulic pumps, etc., Elliott Bros. (London), Limited, will employ 500 men on all types of electrical and mechanical precision instruments, while C.A.V., Limited, will manufacture fuel injection pumps, electrical equipment, etc., employing 1,200 persons.

SHORTAGE OF MATERIALS in the shipbuilding industry was referred to by Mr. F. C. Pyman, managing director of William Gray & Company, Limited, West Hartlepool, recently. He said that shortages of teak, other timber, linseed oil and rubber were understandable, but it was not clear why the choice of electrical equipment, upholstery and other equipment should be so limited. He added that shipbuilders had a good claim on these things as the earnings of British ships formed a vital export.

WITH THE INSTALLATION OF semi-mechanised plant and a gradual move toward full mechanisation, the Western Light Casting Foundries, Limited, of Gowerton, South Wales, hope to obtain a 10-fold increase in their output of light castings at their recently acquired site. This increase, it is estimated, should be achieved within three to six months. It is the intention of the firm to confine its activities for the present to the manufacture of such castings as will be required by the Government for housing schemes.

THE THIRD ANNUAL REPORT of the English National Council of Development Committees, which was formed to co-ordinate and guide growth in local industries, states that the policy of balanced industry and full-time employment makes central direction by the Government necessary, but the wisdom of central decisions may be imperilled if there are not in being strong, locally-formed development committees which can bring to the regional and national Government organisation the needs and possibilities of each district.

CONSTRUCTION OF THE new Tees dock, projected by the Tees Conservancy Commission, will be a three years' job. Imperial Chemical Industries' new £10,000,000 factory at Wilton, on the south bank of the Tees, is expected to be in production within two years, and it is hoped that this will synchronise with the erection of the new £8,000,000 steel plant projected by Dorman, Long & Company, Limited, on an adjacent site. These were the salient facts which emerged from the principal speeches at a luncheon following an inspection of the river by M.P.s, leading industrialists and representatives of local authorities. "I know of no other area in the Kingdom," said Lord Greenwood, chairman of Dorman, Long & Company, Limited, "with as large projects ready as this area of Tees-side."

1886

Sixty years ago the use of oxygen was almost entirely confined to the magic-lantern-like spotlights of the Victorian theatre and the daily output was measured in a few hundred cubic feet. Today, in the service of industry and medicine, many millions of cubic feet are produced daily. Its use embraces such diverse applications as the conditioning, cutting and welding of steel, oxygen supply for high altitude flying, and anaesthesia and resuscitation. The British Oxygen Co. Ltd. is proud of the part it has played during the last sixty years in making the oxygen now so indispensable to industry and medicine.

1946

The British Oxygen Company Ltd

London and Branches

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NEW COMPANIES

("Limited" is understood. Figures indicate capital. Names are of directors unless otherwise stated. Information compiled by Jordan & Sons, 116, Chancery Lane, London, W.C.2.)

Virgo (Engineers), 40, Edward Street, Brighton—£2,000.

Spark Alloys—£30,000. J. Carman, 21, Albert Road, Ramsgate, subscriber.

Smith's Engineering Industries, 14a, Fossgate, York—£5,000. G. W. and E. Smith.

F. Webb & Company (Engineers), 90, Albert Road, Luton—£3,000. L. W. Brown and H. Craft.

Kine Engineering Company, 3a, Mill Street, Redhill, Surrey—£1,000. E. C. and W. J. Meldrum.

Aluminium Distributors, 12, Whitehall, London, S.W.—£1,000. J. P. Evans and J. A. Findlay.

Rochdale Pistons & Liners, 14, Nelson Square, Bolton—£2,000. H. Dyson and J. M. Howarth.

A. H. Garrett (Engineers), 255, Pentonville Road, Kings Cross, London, N.1—£1,000. A. H. Garrett.

Principality Plating Company, 146, City Road, Cardiff—£1,000. E. W. Tucker and P. V. Dixon.

Dextra (Tools)—£1,000. I. O. Gendall, 42, Lancaster Mews, Hyde Park, London, W.2, and K. Eldridge.

C. F. Boyle, 90, Jermyn Street, London, S.W.1—Engineers. £30,000. E. H. Doyle and H. C. Hamlin.

B. Morris Metals, Wilson Street, North Monkwearmouth, Sunderland—£2,000. B. Dresner and W. A. J. Turr.

Technotex, 6, Bank Chambers, Station Road, Finchley, London, N.3—Manufacturers of machinery. £1,000.

A. E. Piggott & Sons, Redcross Street, Leicester—Scrap metal dealers, etc. £10,000. E. and S. A. Piggott.

Bomac Engineering Company, 15, Whitehall, London, S.W.1—£10,000. Mechanical and marine engineers, etc.

Denver Chemical & Metal Refining Company, 66, Finsbury Pavement, London, E.C.2—£2,000. A. E. and H. Malley.

Bell Giddins & Company—Engineers, etc. £2,000. D. D. C. Giddins, Rayne House, Rayne, Essex. subscriber.

Ridgehill Metal Spinning Company, Wood Street, Ashton-under-Lyne—£2,000. A. W. Maycock, A. Gill and G. Reid.

British Manufactured Bearings, Victory Works, High Street, Crawley, Sussex—£2,000. J. Bass, senr., and J. Bass, junr.

F. E. Callow (Engineers), 30, Waterloo Road, Wolverhampton—£5,000. R. Mackie, H. H. Clay, and F. E. Callow.

Tipson Engineering Company, Abbey Green, Nuneaton, Warwicks—£5,000. V. Tipson, F. R. Spiers, and A. Smith.

R. Grice & Sons, 14, Wilford Road, Ruddington, Notts—General engineers, etc. £3,000. R., H. P., and R. Grice, junr.

Steelba Supplies, New Road, Halesowen—Machinery and metal merchants, etc. £3,000. F. J., R. E., R. C. and S. S. Downing.

Coldberry Lead Company, 5, Frederick Street, Sunderland—£100,000. S. Walton-Brown, G. Poole, and A. E. Morgan.

M. P. Glass & Company, 98, Cheapside, Birmingham, 5—General engineers, etc. £1,500. M. P. Glass and T. C. Roodley.

A. & E. Woodward, 29-31, Salthouse Lane, Hull—Marine and general engineers. £3,000. J. E. V. and A. E. Woodward.

Joyco Engineering Company—£2,500. K. F. V. Joyce, 164, Kenton Lane, Harrow Weald, J. W. May, and W. H. Cowderoy.

Electrification, Hill Top, Foulridge, near Colne—Ironmasters, founders and workers, etc. £1,000. J. Bailey and C. Clarke.

British Engineering Trade & Export Company, 18, Felhampton Road, London, S.E.9—£5,000. W. J. Morris and E. Holder.

A. F. Exton, Acacia Road, Bournville—Manufacturers of jigs, tools, gauges, machinery, etc. £3,000. A. F. and C. W. Exton.

Cross & Entwistle (Chorley), Apex Works, Arley Street, Chorley, Lancs—Engineers, etc. £2,000. E. Cross and W. Entwistle.

G. E. Parsons & Sons (Hinges), 8, St. George's Place, Birmingham—General brassfounders, etc. £1,000. G. E. Parsons.

Tractors (Bath), 6a, North Parade, Bath—Manufacturers of traction and other agricultural and dairy machines, etc. £10,000.

Newdigate Engineering Company, 11a, Newdigate Road, Coventry—£5,000. H. Weston, L. H. Meeson, R. Naul, and F. G. Bale.

Clifford Race, Arden Works, Fenton Road, Halifax—Mechanical and general engineers, etc. £1,000. C. Race and C. A. Mitchell.

D. J. Engineering Company, Imperial Court, 6, Basil Street, Knightsbridge, London, S.W.1—£1,000. C. C. Penfold and J. T. Cooper.

Bennett Engineering Works, 347, Forest Road, London, E.17—£2,000. M. and L. G. Holland, A. Needham, and S. J. Curtis.

A. E. Ward (Tunbridge Wells), 4, Avon Street, Tunbridge Wells—General engineers, etc. £1,500. A. E. Ward and D. Fuggle.

West Bromwich Casement & Engineering Company, George Street, West Bromwich—£15,000. C. F. and R. Bennett and G. Spencer.

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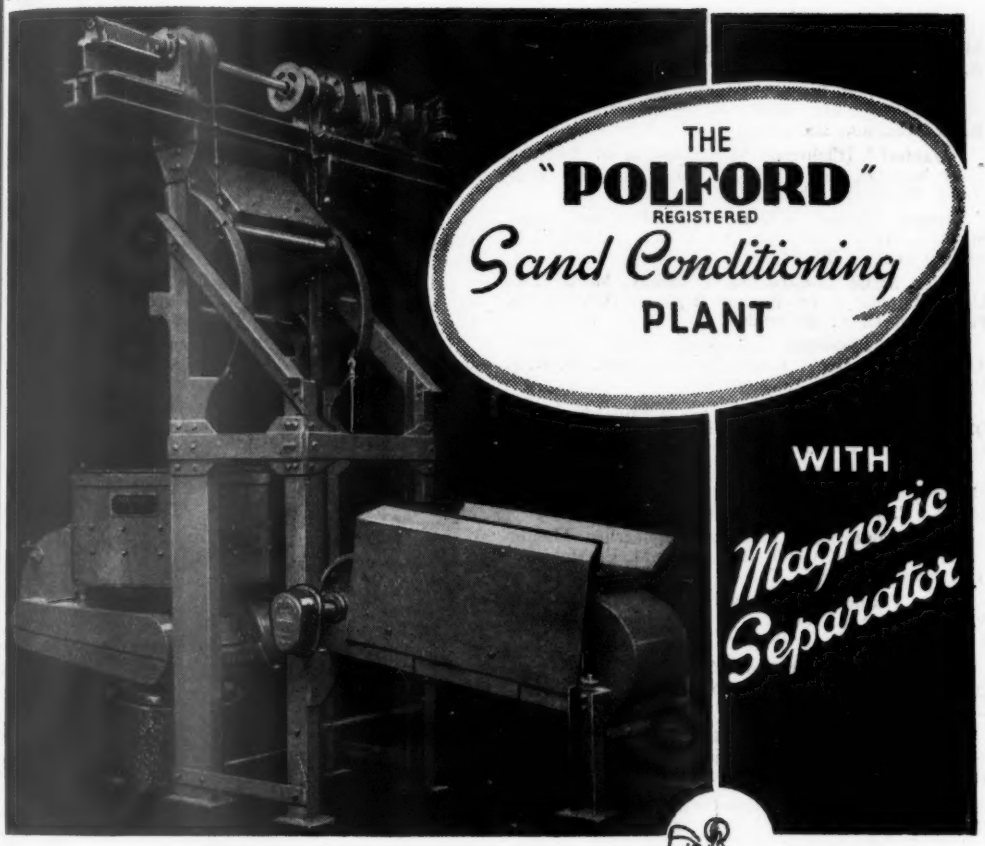

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R. M. Parkinson, Vernon Place, Cheltenham—Marine, motor and general engineers, etc. £3,000. R. M. and H. M. Parkinson.

S.K.B. (Great Britain)—Manufacturers of ball and other bearings, etc. £100. W. F. Eager, 88a, High Road, Wembley, subscriber.

"Waldorf" (Lighters)—Manufacturers of ball and other bearings, etc. £1,000. W. F. Eager, 88a, High Road, Wembley, subscriber.

Richard Mather & Son, 150, Shoreham Street, Sheffield—Tool manufacturers, etc. £12,000. H. Mather and G. Brightmore.

Sussex Metal Construction Company, Mead Lane, Upper Bognor Road, Bognor Regis—£1,000. A. A. Payne and D. A. Reynolds.

Criton Engineering Company, Criton Works, Arterial Road, Orsett, Grays, Essex—£1,000. S. R. J. Crick and P. M. C. Houston.

Mills & Fenton (Oldham), 249, Manchester Street, Oldham—Engineers, sheet-metal workers, etc. £2,000. S. L. Fenton, G. and L. Mills.

P. Foicik, Son & Company, 36-8, Western Road, Plaistow, London, E.13—Vitreous enamellers, etc. £2,000. R. J. and P. Foicik.

Cape Engineering Company, Whymering Manor, Cosham, Hants—£10,000. L. E. and M. E. Metcalfe, G. Ramage, and T. G. Turner.

Bates Textile Machinery Company (Leicester), Wyvern House, 65, London Road, Leicester—£10,000. E. B. Bates and G. L. Rogers.

N.F.B. Displacement Pump Company, 24-28, Lombard Street, London, E.C.2—£25,000. T. T. McCreath, E. S. Millar and N. F. Brown.

Penzance Shippers & Salvors, Albert Wharf, Penzance—Scrap-metal merchants, etc. £1,000. R. H. Watkin and H. Simpson.

Dolphin Industrial Developments, 12, Station Road, Reading—Agents for machinery, engines, etc. £10,000. J. R. V. Dolphin and H. E. Pim.

Johnson Foundries, Adswood Road, Stockport—£5,000. A. Johnson, J. A. Hartley, B. B. Dearden, A. W. Isherwood, and J. Mellors.

Buco, Torrens Works, Torrens Street, London, E.C.1—Manufacturers of agricultural machinery, etc. £1,000. R. A., A. and J. B. Bucher.

A. J. Tillett & Company, 90, Jermyn Street, London, S.W.1—Dealers in metals, machinery, tools, etc. £1,000. A. J. Tillett and L. E. Pinches.

Hale & Stanley, Wilton Street, Denton, Manchester—Brass, iron, aluminium and general metal founders. £3,000. H. B. Hale and G. W. Stanley.

Sunbury-on-Thames Plating Company, 25a, Hanworth Road, Sunbury-on-Thames—Engineers, platers, etc. £1,000. H. L. Oates and G. W. Zimmer.

OBITUARY

MR. PETER SIMPSON, formerly cashier of the Carron Company, has died suddenly.

MR. JAMES EDWARDS, works manager of the Staveley Coal & Iron Company, Limited, has died at the age of 60.

MR. EDWIN JAMES STEVEN, a director of Melvin & Gillespie, Limited, engineers, of 28, Charles Street, Glasgow, died recently.

MR. WILLIAM RICHARD HAMLYN, a director of Goodrich & Hamlyn, Limited, mechanical engineers, of Oldbury, Worcs., died recently.

MR. CHARLES HENRY FARRINGTON, a director of Eyland & Sons, Limited, malleable-iron and brass founders, etc., of Walsall, has died at the age of 77.

MR. JOHN THOMSON, a director of Sir William Arrol & Company, Limited, Glasgow, and works manager at their Dalmarnock Works for the past 30 years, died recently.

MR. JOHN HUGHES, joint managing director of Tweedales & Smalley (1920), Limited, of Rochdale, textile machinery makers, died suddenly on October 3. He was 62 years of age.

MR. J. N. ROBERTS, chief buyer of the Carborundum Company, Limited, Manchester, died on October 5 after a short illness. He joined the company in 1915, and his death occurred on his 50th birthday.

MR. WALTER SAMUEL WILKINS, who has died after a short illness, was governing director of Wilkins & Mitchell, Limited, manufacturers of machine-tool and power presses, etc., of Darlaston, Staffs.

MR. CHARLES W. WRIGHT, technical adviser on steel production to Thos. Firth & John Brown, Limited, died recently. He was 59 years of age. He was a member of the Electric Process and Steel Practice Sub-committees of the Iron and Steel Institute.

MR. FREDERICK THOMAS BERSEY, founder and chairman of the Laystall Engineering Company, Limited, of Southwark, London, S.E.1, and chairman of Joshua Bigwood & Son, Limited, engineers and ironfounders, of Wolverhampton, died recently.

SIR HENRY FRANK HEATH died suddenly on October 5 at the age of 82. When the Department of Scientific and Industrial Research was founded in 1916, he was appointed as its administrative head. Sir Frank was a Governor of the Imperial College of Science and Technology, and of the Imperial Institute, and a member of the Colonial Office Research Committee. He achieved an eminent reputation as an educationist.

MR. FREDERICK CHARLES THOMPSON, who has died at the age of 66, had been associated with John Harper & Company, Limited, ironfounders, etc., of Willenhall, for 40 years, and for the last 10 years was also managing director of George Dyke & Son, Limited, manufacturers of door bolts, drop forgings, etc., of Willenhall. Mr. Thompson was for some time chairman of the local hardware group of the Midland Door Bolt Manufacturers' Association.

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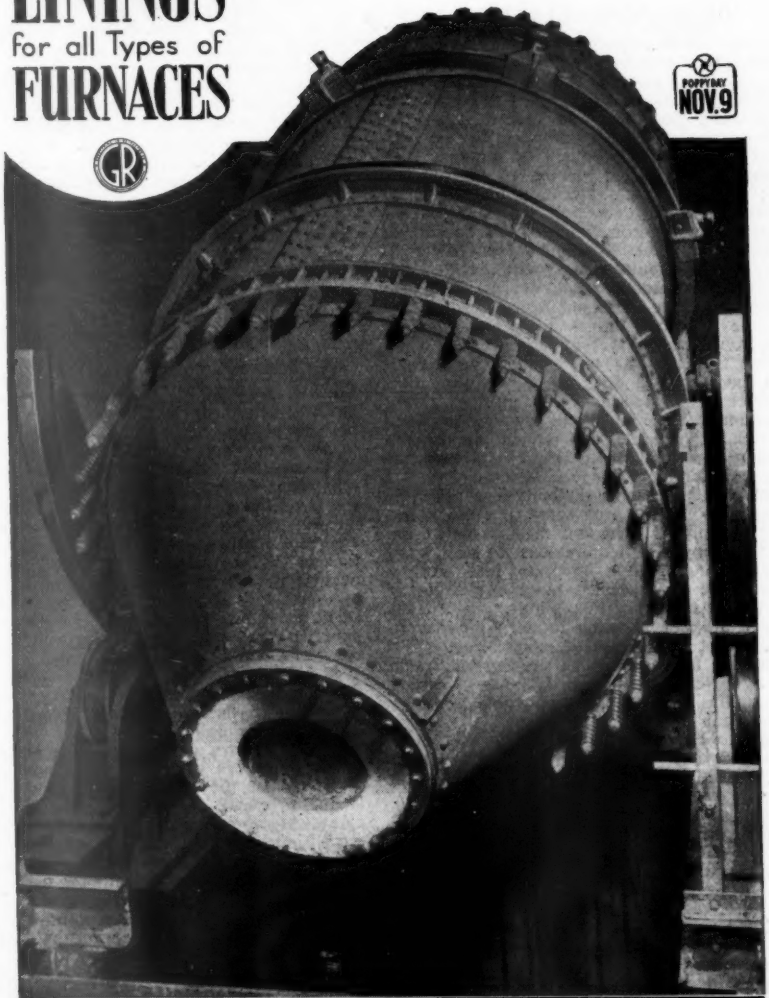

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Raw Material Markets

IRON AND STEEL

The demand for castings is such that difficulty is being experienced by users in getting the deliveries they require, and also in placing further orders. There is a far-reaching demand for light castings, particularly for building purposes, and orders have piled up at the foundries, which are hampered by the scarcity of the right type of labour. At present, their output is not being curtailed because of the shortage of pig-iron; but when extra labour is available, and increased production becomes possible, there will be greater demands for pig-iron, which it will be difficult for the Control to meet. Current output of high-phosphorus iron just about covers requirements, and leaves very little for stock. Lack of fuel, and also labour troubles, prevent additional furnaces going into blast, and the Control's efforts to get imports of foundry pig-iron have not yet materialised.

The jobbing foundries, as well as the general engineering and speciality foundries, are now fully active, and their purchases of special irons represent a very considerable tonnage. The makers of low- and medium-phosphorus grades, hematite, and refined pig-iron are able to keep pace with the calls made upon them, as they have a considerable tonnage in reserve.

In the last few days, some difficulty has arisen in regard to supplies of heavy iron scrap, but this is not in such short supply as light and medium cast iron. Foundries are getting their requirements of steel scrap without much difficulty. It is important that the flow of scrap should be easy, because more of it is being used owing to the stringency in pig-iron.

The Control are not allowing foundry pig-iron to be exported, except in the case of refined iron.

The engineering foundries which use ferro-alloys in their mixtures are experiencing no difficulty in getting supplies. Foundries, generally, are now able to secure limestone and ganister without much trouble.

With regard to cupola coke, practically the whole of the country is now "programmed" by the Fuel Control. Definite tonnages have been allocated to each foundry to cover them to the end of April, 1947. Where supplies so allocated do not reach the foundries' demands, the Control are endeavouring to be helpful and are adjusting the quantities where it is found that a case for an increase has been made out.

The semis market remains as strong as ever. The pressure by the re-rollers for all sizes of billets (squares and flats) and sheet bars is heavy. The re-rollers have many orders for material wanted for essential home purposes, particularly steel for the housing programme, motor construction, the Ministry of Agriculture, collieries, etc. The makers of small bars and strip are greatly involved and they are in urgent need of billets 2 in. to 3 in. square, and flats. A considerable extra tonnage is being made in this country, but this quantity does not offset the shorter supplies received from abroad. It is reported that acquisitions have recently been made which will help the situation later, but still larger quantities are required if the trade is to be free from anxiety during the coming winter. The sheet rollers are in an unenviable position; they have already on hand more work than they can accomplish durinng the next six or nine months and orders are being placed with them by consumers for delivery in Periods II and III of next year, nearly 12 months ahead.

A special "M" form procedure has been adopted in regard to sheets in order to straighten the situation and to remove all dead wood. In the meantime, the re-rollers are glad to take from the steelmakers any defective billets, sheet bars, crops or other classes of steel which can be put to good purpose in re-rolling. Some of the re-rollers have very big demands being made upon them for casement sections, required for the ever-widening housing schemes.

NON-FERROUS METALS

Delegates to the International Tin Conference held in London last week reviewed the present and, in particular, the future world tin position from the angles of both supply and demand. The conference endeavoured to assess the probable trend of consumption in relation to production, bearing in mind the vast amount of rehabilitation work on mines and dredges required in the Far Eastern tin-producing areas. World mine production for tin in 1946 is estimated at 94,000 tons, against a consumption of 137,000 tons. World production in 1947 may be about 142,000 tons. When production permits and restrictions on use are therefore removed, it is expected that world consumption might be at an annual rate of about 190,000 tons. It is not expected that world production will reach a rate of over 200,000 tons per annum until some time during 1949. The conference reached the general conclusion that, after making due allowances for the uncertainties of the future, there is not likely to be an excess supply of tin during the next two years.

The need for a continuous intergovernmental review of the world tin situation was agreed upon. Bearing in mind that the existing international tin agreement is due to expire on December 31 next, the delegates agreed to recommend to their governments the early establishment of an International Tin Study Group. They also agreed to recommend the continuance of the Combined Tin Committee in Washington to make allocations of tin metal during the period of short supply, and also to recommend discussions between the principal interested countries concerning the continuation of the Tin Research Institute.

The arbitrator in the Northern Rhodesian copper belt wage dispute has awarded an extra 2s. a shift in artisans' basic wages retrospective from August 22. After taking strike action on July 16, the artisans returned to work on August 22, having accepted arbitration and an increase in wages of 3s. a shift pending the arbitrator's decision. The present award thus brings the total increase up to 5s. a shift. The artisans' original demand was for a rise of 10s.